

BR-2

Brake System

General Information

Specifications

Item		Specification
Master cylinder	Type	Tandem
	Cylinder I.D.	25.4mm (1.00in)
	Piston stroke	35±1mm (1.38±0.039in)
	Fluid level switch	Provided
Brake booster	Type	8" + 9" Tandem
	Boosting ratio	9 : 1
Front Disc brake	Type	Ventilated disc
	Disc O.D.	320mm (12.60in)
	Disc thickness	28mm (1.10in)
	Caliper piston	Single
	Cylinder I.D.	Ø 63.5mm(2.5 in)
Rear brake	Type	Solid disc
	Disc O.D.	314mm (12.36in)
	Disc thickness	13mm (0.51in)
	Caliper piston	Single
Parking brake	Type	DIH (Drum in hat)
	Drum I.D.	Ø 190mm (7.48in)

NOTICE

O.D. : Outer Diameter

I.D : Inner Diameter

General Information

BR-3

Specification (ESP)

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	Total control (ABS, EBD, TCS, ESP)
	Type	Motor, valve relay intergrated type	
	Operating Voltage	10 ~ 17V	
	Operating Temperature	-40 ~ 110°C	
	Motor power	270W	
Warning lamp	Min. Operating Voltage	12V	
	Max. Current consumption	Max. 100mA	
Active Wheel speed sensor	Supply voltage	DC 4.5 ~ 20V	
	Output current low	4.05 ~ 4.95mA	
	Output current high	11.8~ 16.8mA	
	Output range	Front : 1 ~ 2000Hz Rear : 1 ~ 2500Hz	
	Tone wheel	Front : 46 teeth Rear : 47 teeth	
	Air gap	0.4 ~ 1.5mm	
Steering Wheel Angle Sensor	Operating Voltage	8 ~ 16V	
	Output measurement range	-780 ~ +199.9°	
	Operating Angular velocity	0 ~ 1016°/sec	
Yaw rate & Lateral G sensor (CAN TYPE)	Operating Voltage	8 V ~ 16V	
	Current Consumption	Max. 250mA	
	Yaw rate sensor measurement range	± 75°/sec	
	Lateral G sensor measurement range	± 1.7gN	

BR-4

Brake System

Service Standard

Items	Standard vale
Brake pedal height	210.4mm (8.28in)
Brake pedal stroke	132mm (5.20in)
Stop lamp clearance	1.0 ~ 1.5mm (0.04 ~ 0.06in)
Brake pedal free play	3 ~ 8mm (0.12 ~ 0.31in)
Front brake disc thickness	28mm (1.10in)
Front brake disc pad thickness	10.5mm (0.41in)
Rear brake disc thickness	13mm (0.51in)
Rear brake disc pad thickness	10mm (0.39in)

Tightening Torques

Items	N.m	kgf.m	lb-ft
Master cylinder to brake booster	12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Brake booster mounting nuts	14.7 ~ 21.6	1.5 ~ 2.2	10.9 ~ 15.9
Air bleeding screw	6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
Brake tube flare nuts	12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Front caliper guide rod bolts	21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Rear caliper guide rod bolts	21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Front caliper assembly to knuckle	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Rear caliper assembly to knuckle	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Brake hose to caliper	24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member bracket bolts	14.7 ~ 21.6	1.5 ~ 2.2	10.9 ~ 15.9
Brake pedal shaft nut	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Stop lamp switch lock nut	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Wheel speed sensor mounting bolt	6.9 ~ 10.8	0.7 ~ 1.1	5.1 ~ 8.0
HECU bracket mounting bolt	16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Yaw rate & G sensor mounting bolts	6.9 ~ 8.8	0.7 ~ 0.9	5.1 ~ 6.5

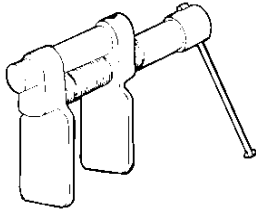
General Information

BR-5

Lubricants

Items	Recommended	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and bolt	Chassis grease	As required
Parking brake shoe and backing plate contacting surface	Heat resistance grease	As required
Front caliper guide rod and boot	AI-11P	1.0 ~ 1.5g
Rear caliper guide rod and boot	AI-11P	0.8 ~ 1.3g

Special Service Tools

Tool (Number and Name)	Illustration	Use
09581-11000 Piston expander	 EJDA043A	Spreading the front disc brake piston

BR-6

Brake System

Troubleshooting

Problem Symptoms Table

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the like cause of the problem. Check each part in order.

If necessary, replace these parts.

Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance (Out of adjustment) 5. Master cylinder (Inoperative)	repair air-bleed replace adjust replace
Brake drag	1. Brake pedal free play (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Rear brake shoe clearance (Out of adjustment) 5. Pad or lining (Cracked or distorted) 6. Piston (Stuck) 7. Piston (Frozen) 8. Anchor or Return spring (Inoperative) 9. Booster system (Vacuum leaks) 10. Master cylinder (Inoperative)	adjust adjust repair adjust replace replace replace replace repair replace
Brake pull	1. Piston (Sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	replace replace replace replace replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad or lining (Worn) 4. Pad or lining (Cracked or distorted) 5. Rear brake shoe clearance (Out of adjustment) 6. Pad or lining (Oily) 7. Pad or lining (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	repair air-bleed replace replace adjust adjust replace replace repair
Noise from brake	1. Pad or lining (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Sliding pin (Worn) 5. Pad or lining (Dirty) 6. Pad or lining (Glazed) 7. Anchor or Return spring (Faulty) 8. Brake pad shim (Damage) 9. Shoe hold-down spring (Damage)	replace adjust replace replace clean replace replace replace replace
Brake fades	1. master cylinder	replace

General Information

BR-7

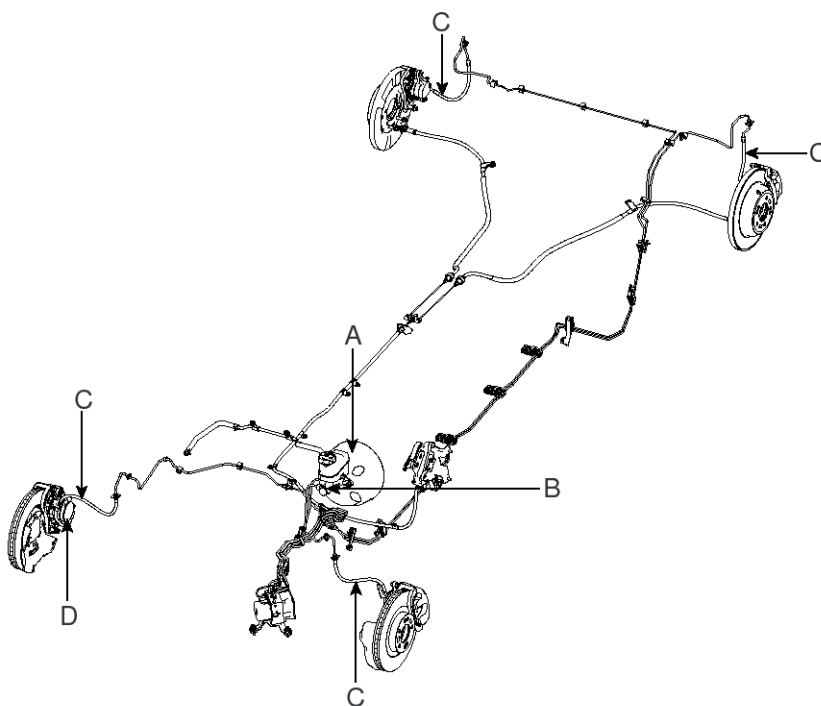
Symptom	Suspect Area	Reference
Brake vibration, pulsation	1. brake booster 2. pedal free play 3. master cylinder 4. caliper 5. master cylinder cap seal 6. damaged brake lines	replace adjust replace replace replace replace
Brake Chatter	Brake chatter is usually caused by loose or worn components, or glazed or burnt linings. Rotors with hard spots can also contribute to brake chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.	

Brake System

Operation and Leakage Check

Check all of the following items

Component	Procedure
Brake Booster (A)	Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.
Piston cup and pressure cup inspection (B)	• Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. Replace the master cylinder as an assembly if the pedal does not work properly or if there is damage or signs of fluid leakage. • Check for a difference in brake pedal stroke between quick and slow brake applications. Replace the master cylinder if there is a difference in pedal stroke.
Brake hoses (C)	Look for damage or signs of fluid leakage. Replace the brake hose with a new one if it is damaged or leaking.
Caliper piston seal and piston boots (D)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, disassemble and inspect the brake caliper. Replace the boots and seals with new ones whenever the brake caliper is disassembled.



SBHBR9321L

Brake System

BR-9

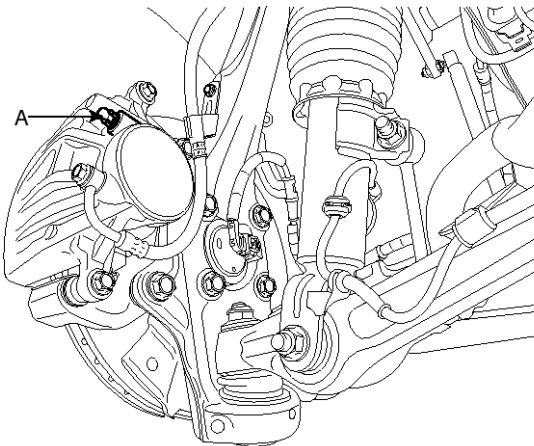
Brake System Bleeding

⚠ CAUTION

- Do not reuse the drained fluid.
- Always use genuine DOT3/DOT4 brake Fluid.
Using a non-genuine DOT3/DOT4 brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.
- The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.

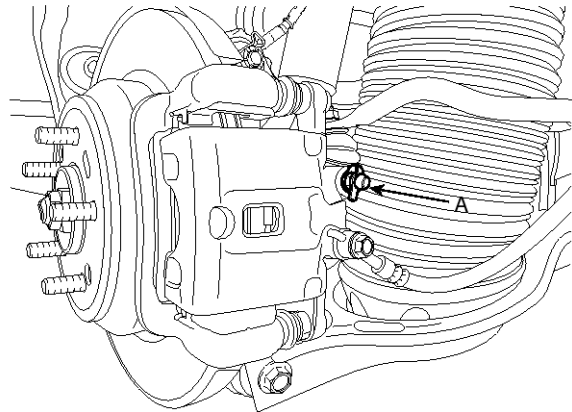
1. Make sure the brake fluid in the reservoir is at the MAX(upper) level line.
2. Have someone slowly pump the brake pedal several times, and then apply pressure.
3. Loosen the right-rear brake bleed screw (A) to allow air to escape from the system. Then tighten the bleed screw securely.

Front



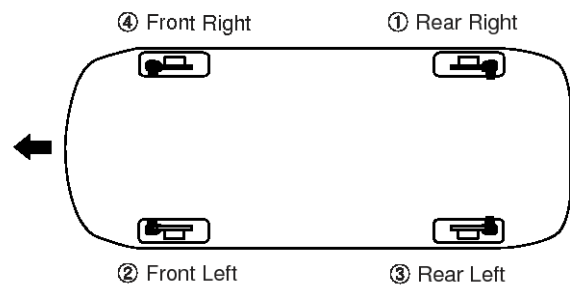
SBHBR8301D

Rear



SBHBR8302D

4. Repeat the procedure for wheel in the sequence shown below until air bubbles no longer appear in the fluid.



EJKE003B

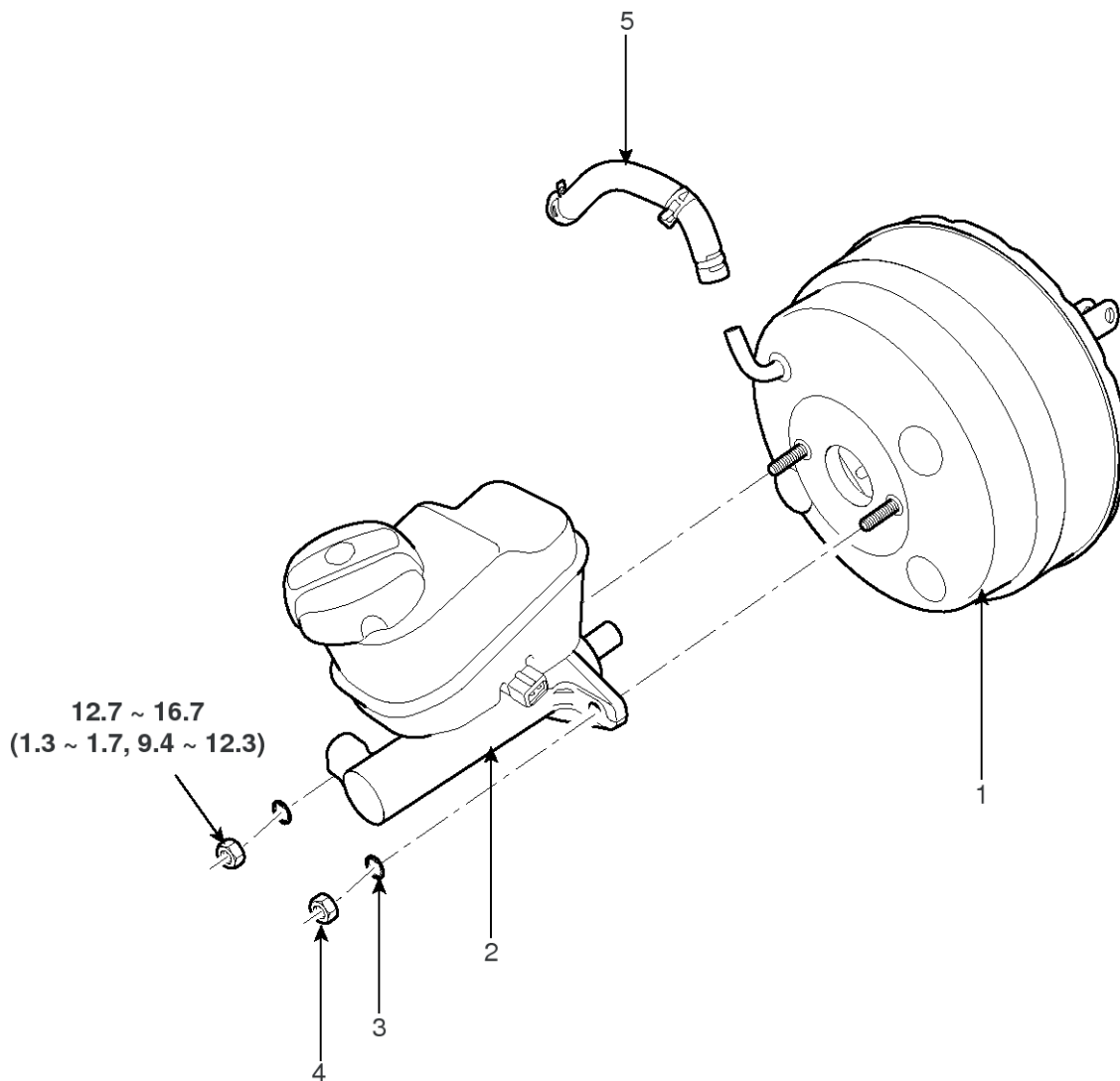
5. Refill the master cylinder reservoir to MAX(upper) level line.

BR-10

Brake System

Brake Booster

Components



Torque : N.m (kgf.m, lb-ft)

SBHBR9327L

- 1. Brake booster
- 2. Master cylinder assembly
- 3. Washer

- 4. Nut
- 5. Vacuum hose

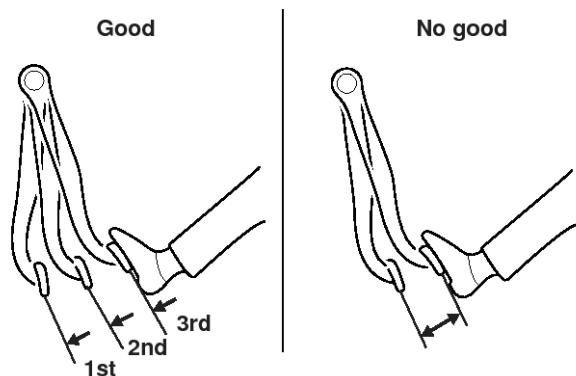
Brake System

BR-11

Brake Booster Operating Test

For simple checking of the brake booster operation, carry out the following tests.

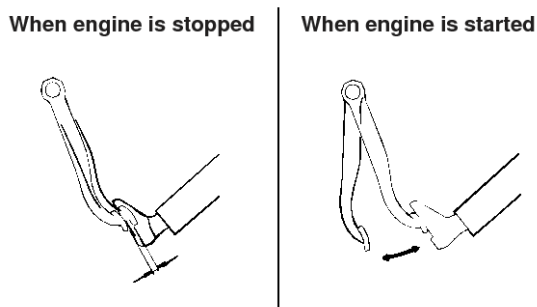
1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is inoperative.



EJRF500B

2. With the engine stopped, step on the brake pedal several times.

Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is inoperative.



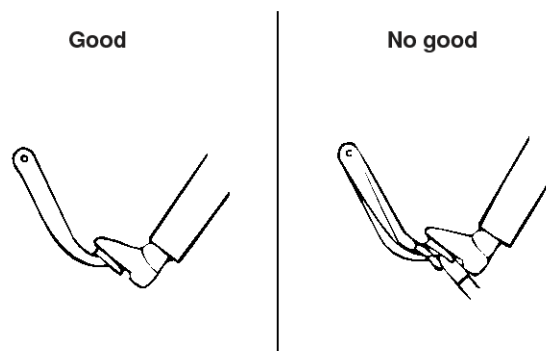
SCMBR6500L

3. With the engine running, step on the brake pedal and then stop the engine.

Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is inoperative.

If the above three tests are okay, the booster performance can be determined as good.

Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for malfunction.



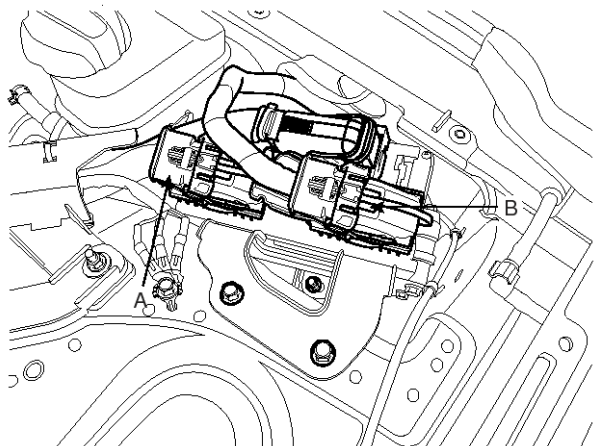
EJRF500C

BR-12

Brake System

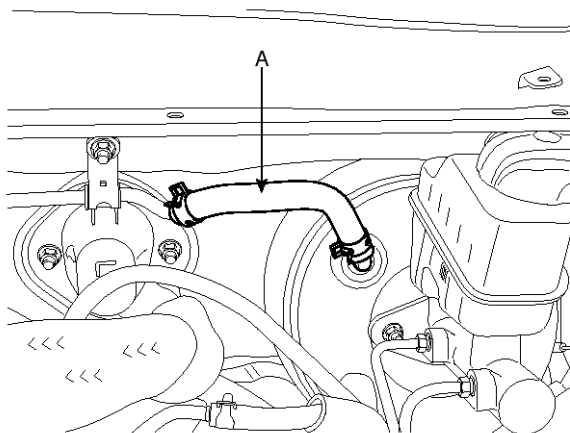
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the cover.
3. Disconnect the ECM connector (A) and TCM connector (B). And then take the protector of control harness off.



SBHBR9332L

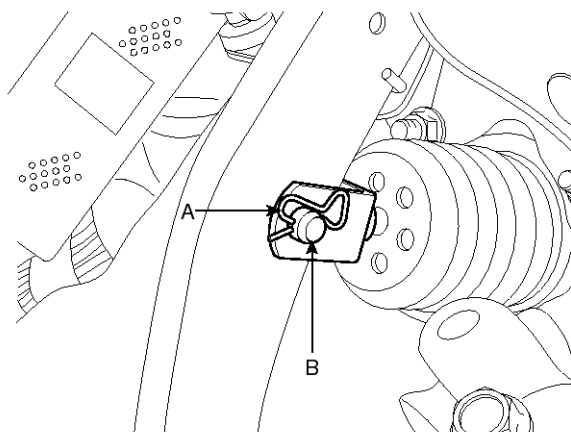
4. Disconnect the vacuum hose (A) from the brake booster.



SBHBR8305D

5. Remove the master cylinder. (Refer to Master cylinder)

6. Remove the snap pin (A) and clevis pin (B).

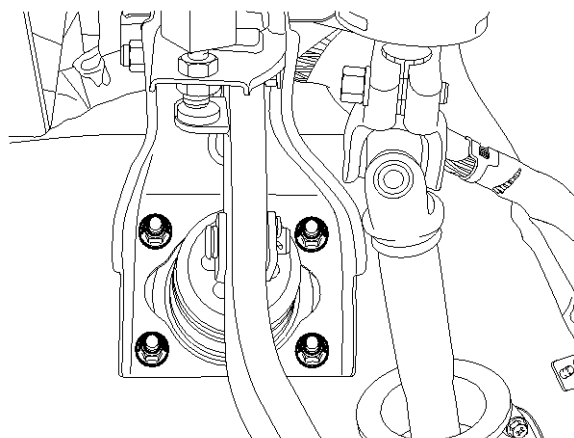


SBHBR8306D

7. Remove the mounting nuts.

Tightening torque :

14.7 ~ 21.6N.m (1.5 ~ 2.2kgf.m, 10.9 ~ 15.9lb-ft)

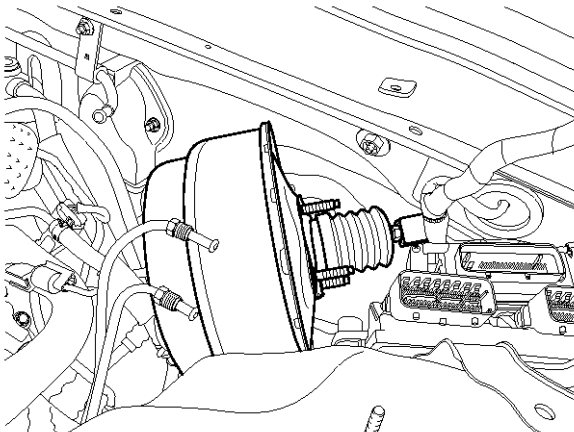


SBHBR8307D

Brake System

BR-13

8. Remove the brake booster.



SBHBR8308D

Inspection

1. Inspect the check valve in the vacuum hose.

CAUTION

Do not remove the check valve from the vacuum hose.

2. Check the boot for damage.

Installation

1. Installation is the reverse of removal.

CAUTION

- Before installing the pin, apply the grease to the joint pin.
- Use a new snap pin whenever installing.

2. After installing, bleed the brake system. (Refer to Brake system bleeding)

3. Adjust the brake pedal height and free play.

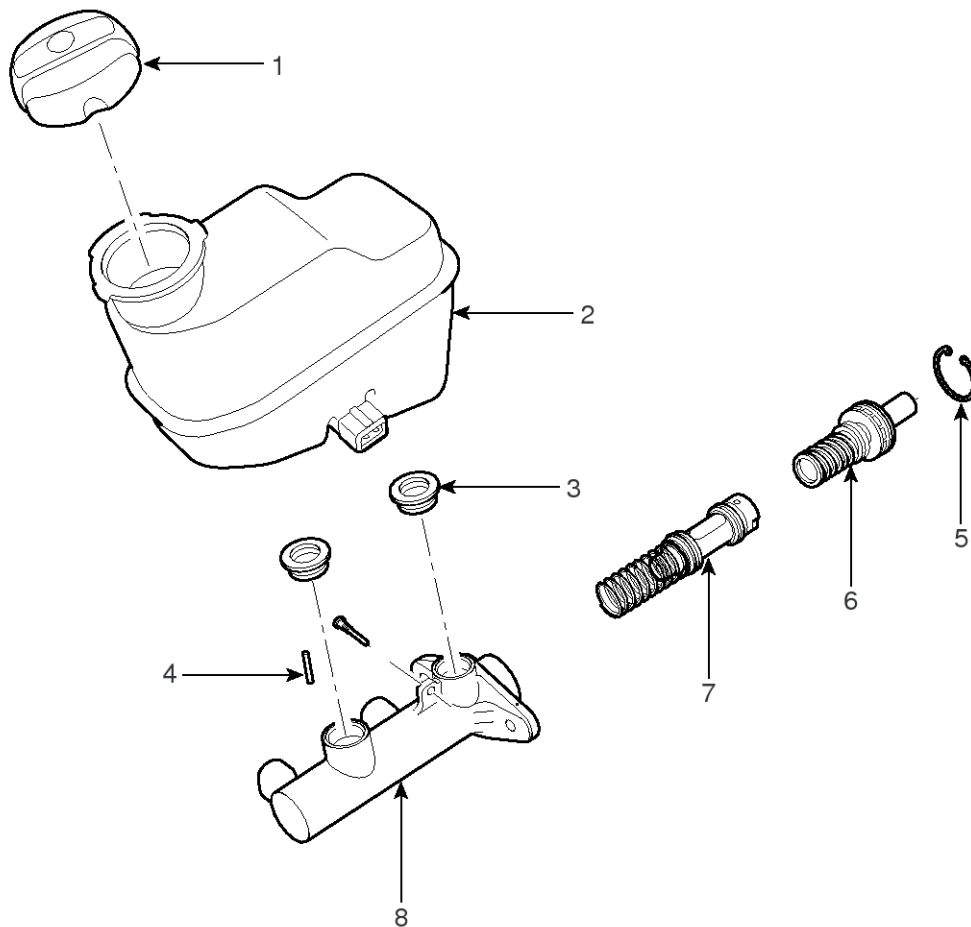
(Refer to Brake pedal height and free play adjustment)

BR-14

Brake System

Master Cylinder

Components



SBHBR8309D

- 1. Reservoir cap
- 2. Reservoir
- 3. Grommet
- 4. Cylinder pin

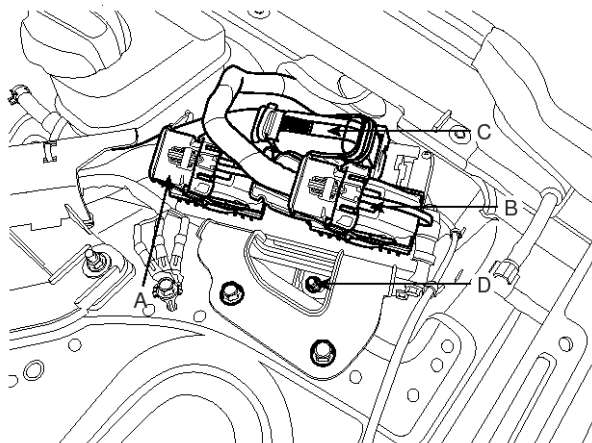
- 5. Retainer
- 6. Primary piston assembly
- 7. Secondary piston assembly
- 8. Master cylinder body

Brake System

BR-15

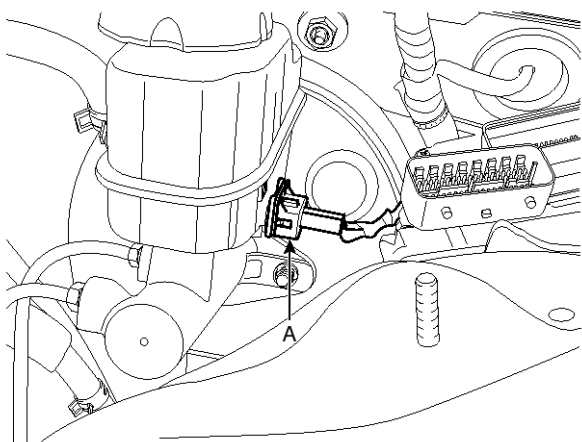
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the cover.
3. Disconnect the ECM connector (A) and TCM connector (B). And then take the protector of control harness off.



SBHBR8304D

4. Disconnect the brake fluid level switch connector (A) from the reservoir.



SBHBR8311D

5. Remove the brake fluid from the master cylinder reservoir with a syringe.

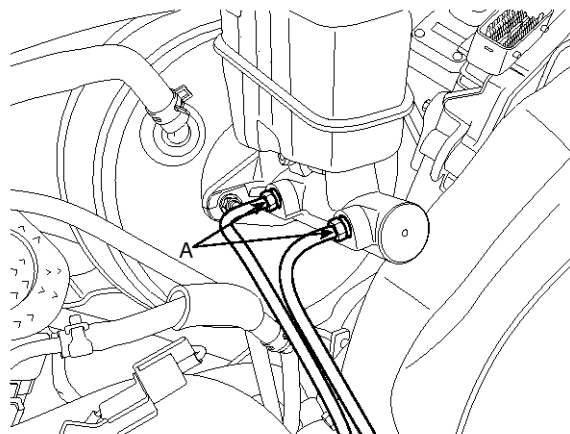
⚠ CAUTION

- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

6. Disconnect the brake tube (B) from the master cylinder by loosening the tube flare nut.

Tightening torque :

18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m , 13.7 ~ 16.7lb-ft)

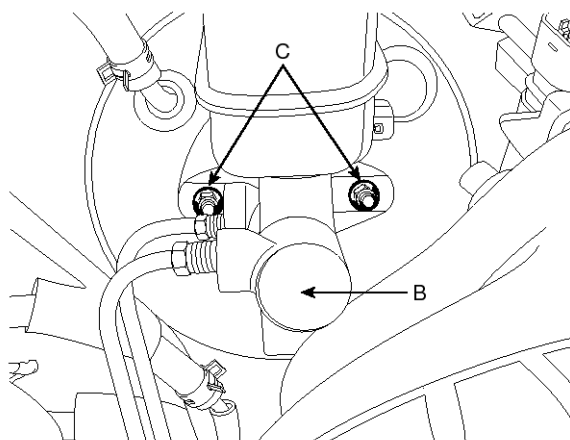


SBHBR8312D

7. Remove the master cylinder (B) from the brake booster after loosening the mounting nuts (C).

Tightening torque :

12.7 ~ 16.7N.m (1.3 ~ 1.7 kgf.m, 9.4 ~ 12.3lb-ft)



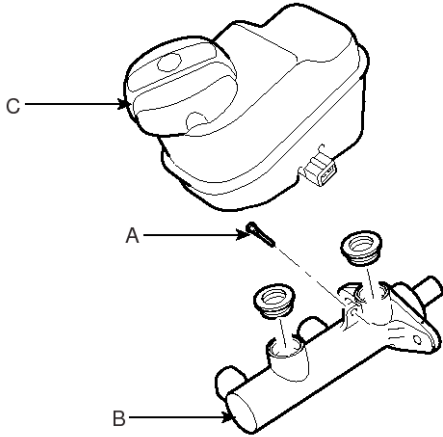
SBHBR8313D

BR-16

Brake System

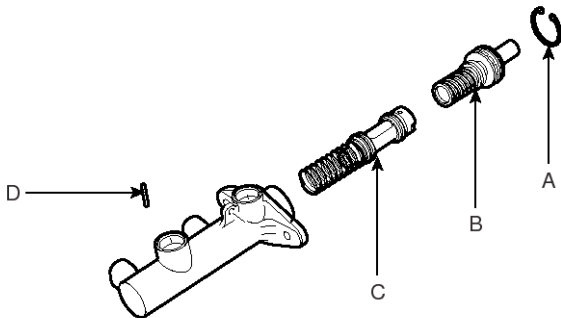
Disassembly

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove the reservoir (C) from the master cylinder (B), after remove mounting screw (A).



SBHBR8314D

3. Remove the retainer ring (A) by using the snap ring pliers.
4. Remove the primary piston assembly (B).
5. Remove the pin (D) with the secondary piston (C) pushed completely using a screwdriver. Remove the secondary piston assembly (C).



SBHBR8315D

NOTICE

Do not disassemble the primary and secondary piston assembly.

Inspection

1. Check the master cylinder bore for rust or scratching.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

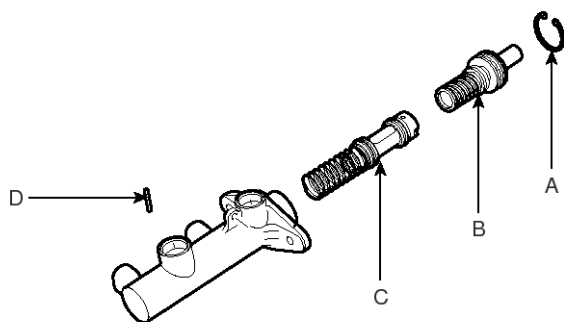
- If the cylinder bore is damaged, replace the master cylinder assembly.
- Wash the contaminated parts in alcohol.

Brake System

BR-17

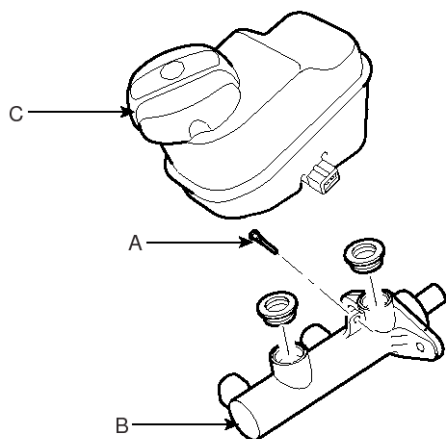
Reassembly

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
2. Carefully insert the springs and pistons in the proper direction.
3. Press the secondary piston (C) with a screwdriver and install the cylinder pin (D).



SBHBR8315D

4. Install the retainer ring (A) after installing primary piston assembly (B).
5. Mount two grommets.
6. Install the reservoir (C) on the cylinder (B), and then install the mounting screw (A).



SBHBR8314D

Installation

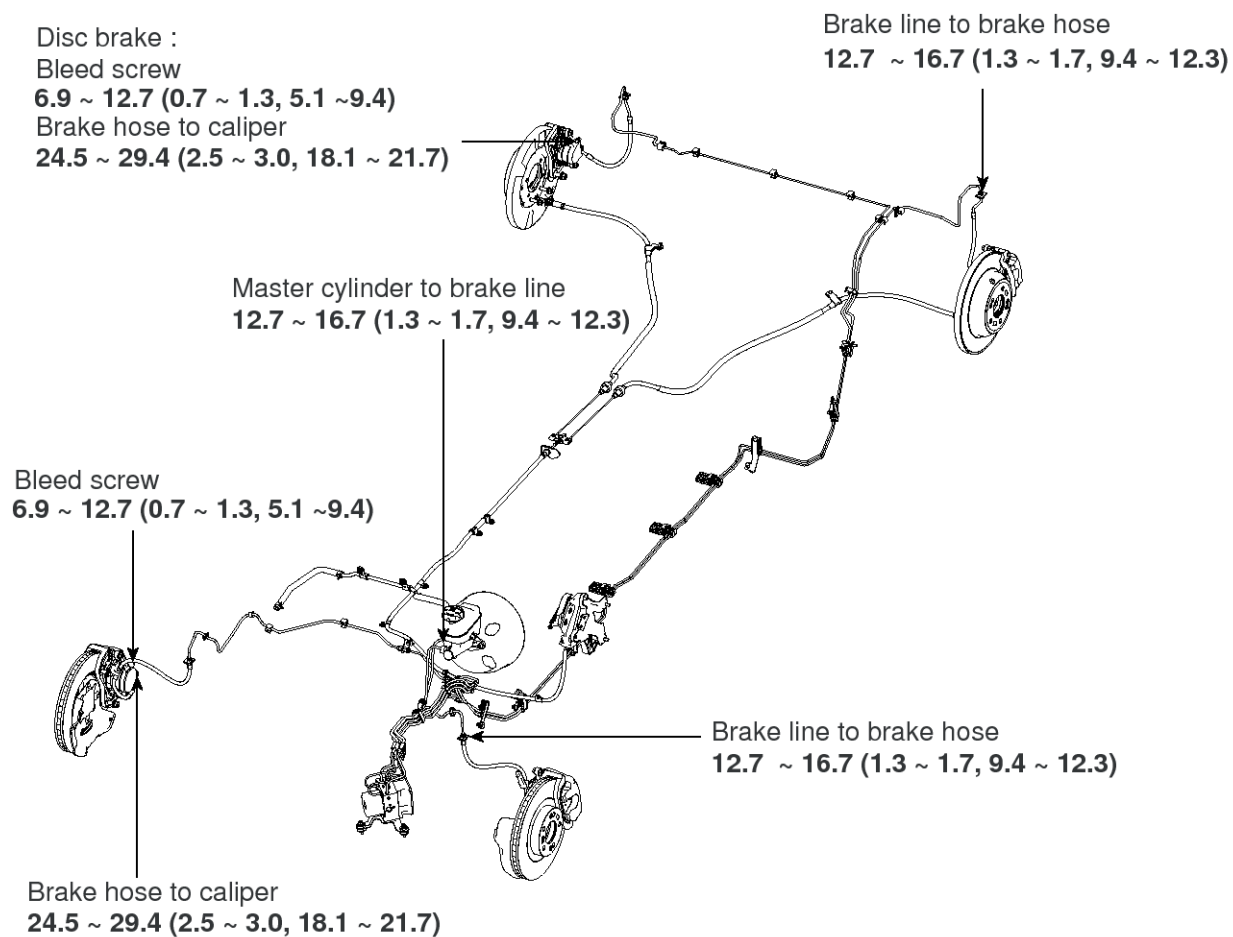
1. Installation is the reverse of removal.
2. After installation, bleed the brake system. (Refer to Brake system bleeding)

BR-18

Brake System

Brake Line

Components



Torque : N.m (kgf.m, lb-ft)

SBHBR9300L

⚠ WARNING

When installing brake hose, be sure to comply with the torque specification to prevent twisted hose.

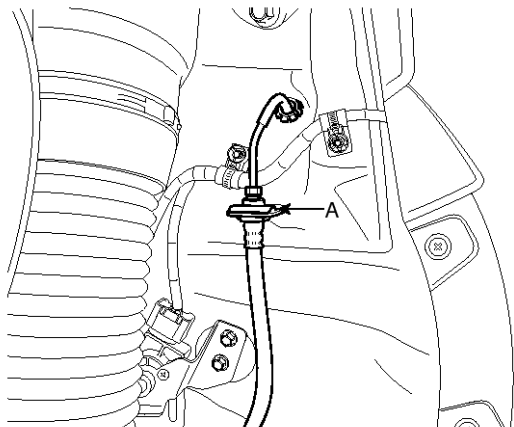
Brake System

BR-19

Removal

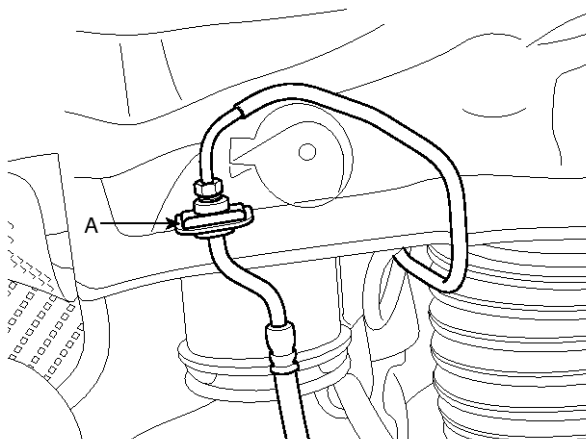
1. Remove the wheel & tire.
2. Remove the brake hose clip (A).

Front



SBHBR8317D

Rear



SBHBR8318D

3. Disconnect the brake tube by loosening the tube flare nut.

Tightening torque :

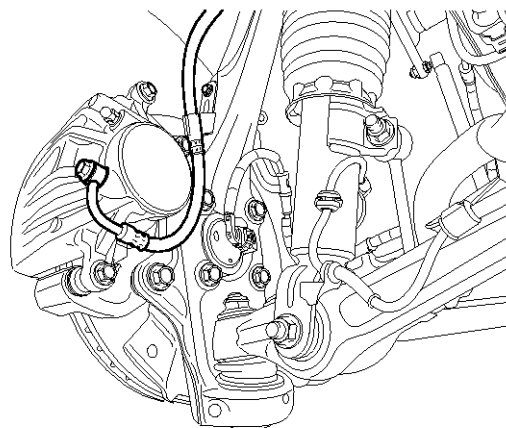
12.7 ~ 16.7N.m (1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft)

4. Disconnect the brake hose from the brake caliper by loosening the bolt.

Tightening torque :

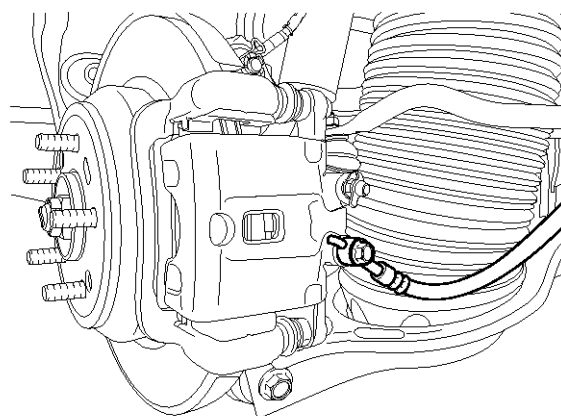
24.5 ~ 29.4N.m (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)

Front



SBHBR8319D

Rear



SBHBR8320D

BR-20

Brake System

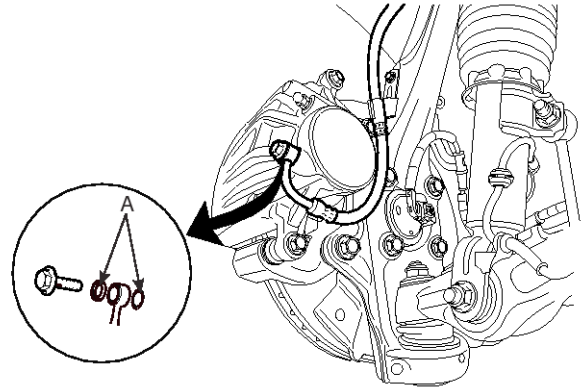
Inspection

1. Check the brake tubes for cracks, crimps and corrosion.
2. Check the brake hoses for cracks, damage and fluid leakage.
3. Check the brake tube flare nuts for damage and fluid leakage.
4. Check the brake hose mounting bracket for crack or deformation.

Installation

1. Installation is the reverse of removal.

 **CAUTION**



SBHBR8321D

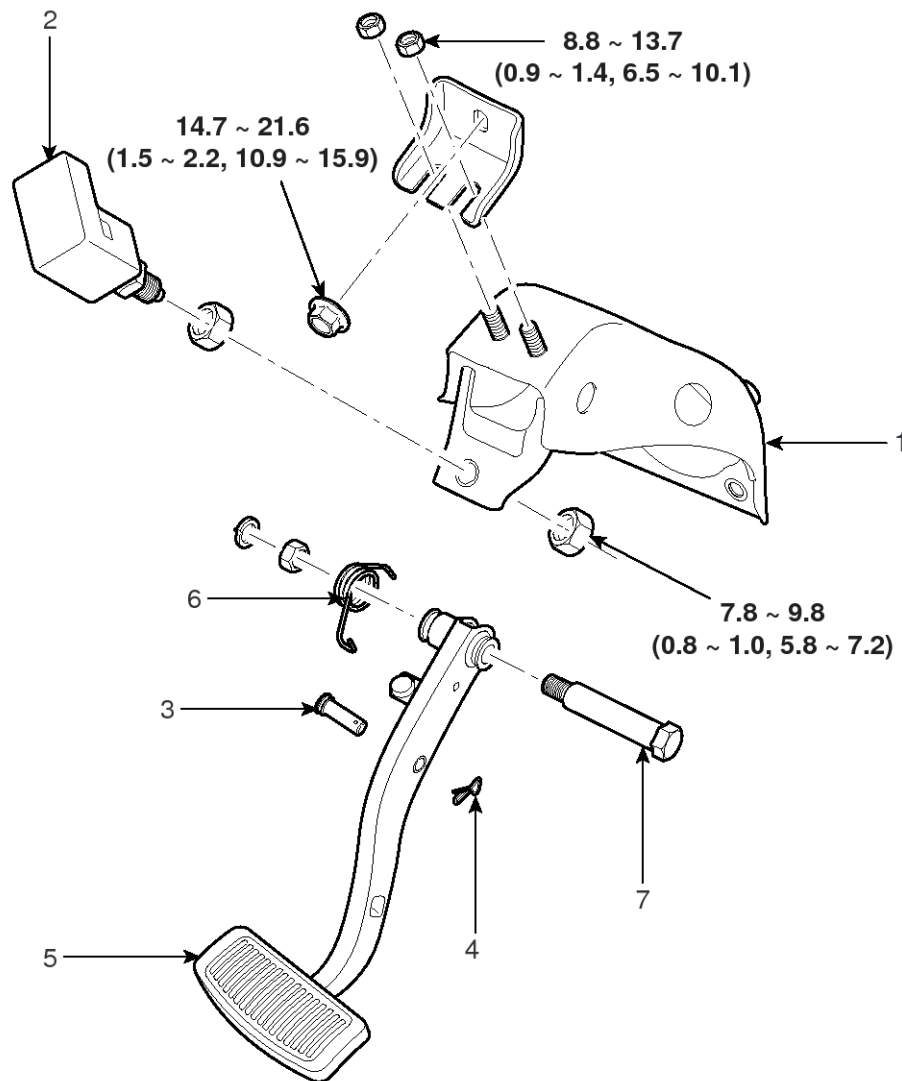
2. After installation, bleed the brake system. (Refer to Brake system bleeding)
3. Check the spilled brake oil.

Brake System

BR-21

Brake Pedal

Components



Torque : N.m (kgf.m, lb-ft)

SBHBR9328L

1. Brake pedal member assembly
2. Stop lamp switch
3. Clevis pin
4. Snap pin

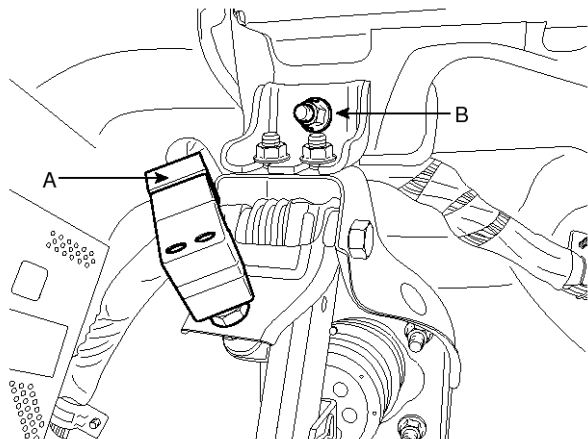
5. Brake pedal
6. Return spring
7. Bolt

BR-22

Brake System

Removal

1. Remove the lower crash pad. (Refer to the Body group- crash pad).
2. Disconnect the stop lamp switch connector (A).



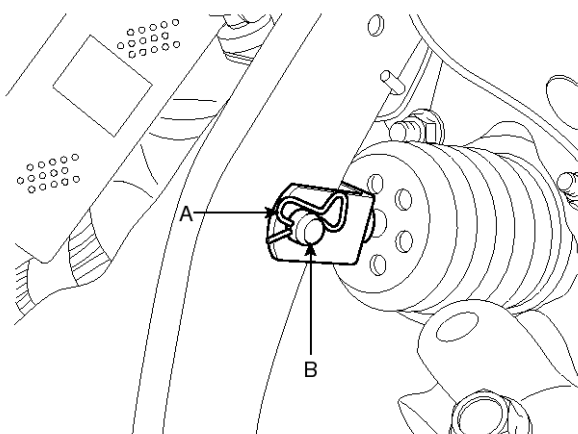
SBHBR8323D

3. Remove the mounting bracket nut (B).

Tightening torque :

14.7 ~ 21.6N.m (1.5 ~ 2.2kgf.m, 10.9 ~ 15.9lb-ft)

4. Remove the snap pin (A) and clevis pin (B).

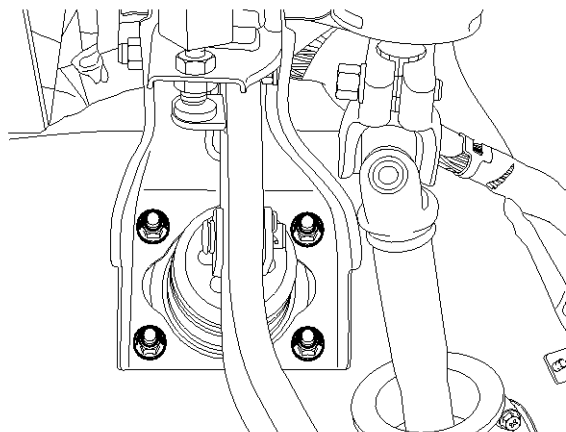


SBHBR8324D

5. Remove the brake pedal member assembly mounting nuts (C) and then remove the brake pedal assembly.

Tightening torque :

14.7 ~ 21.6N.m (1.5 ~ 2.2kgf.m, 10.9 ~ 15.9lb-ft)



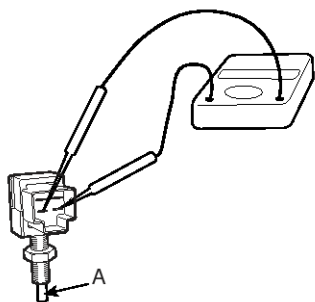
SBHBR8325D

Brake System

BR-23

Inspection

1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch.
 - 1) Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.
 - 2) The stop lamp switch is in good condition if there is no continuity when plunger(A) is pushed.



SCMBR6530D

Installation

1. Installation is the reverse of removal.

CAUTION

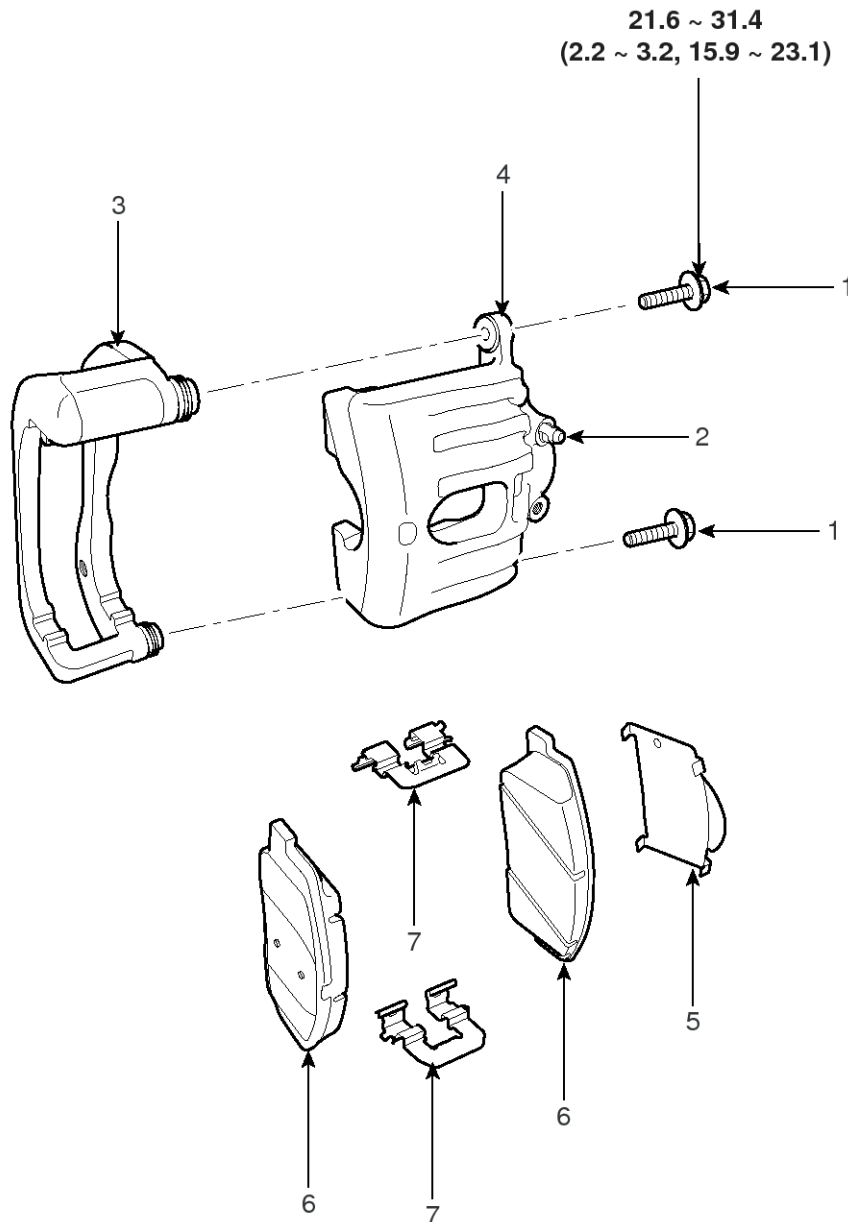
- Before installing the pin, apply the grease to the clevis pin.
 - Use a new snap pin whenever installing.
2. Check the brake pedal operation.

BR-24

Brake System

Front Disc Brake

Components



Torque : N.m (kgf.m, lb-ft)

SBHBR9329L

- 1. Guide rod bolt
- 2. Bleed screw
- 3. Caliper bracket
- 4. Caliper body

- 5. Inner pad shim
- 6. Brake pad
- 7. Pad retainer

Brake System

BR-25

Removal

1. Remove the front wheel & tire.

Tightening torque :

88.3 ~ 107.9N.m (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)

2. Loosen the hose eye-bolt (B) and caliper mounting bolts (C), then remove the front caliper assembly (A).

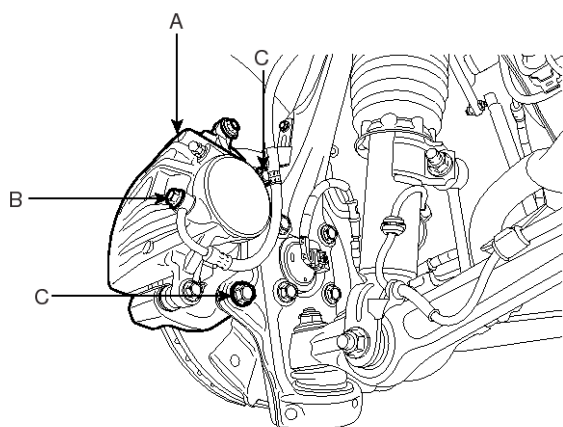
Tightening torque

Brake hose to caliper:

24.5 ~ 29.4N.m (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)

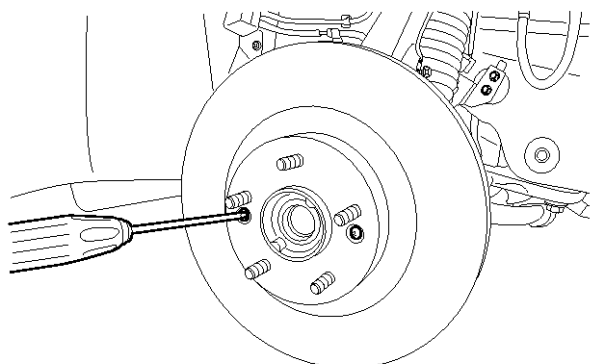
Caliper assembly to knuckle:

78.5 ~ 98.1N.m (8.0 ~ 10.0kgf.m, 57.9 ~ 72.3lb-ft)



SBHBR8327D

3. Remove the front brake disc by loosening the screws.

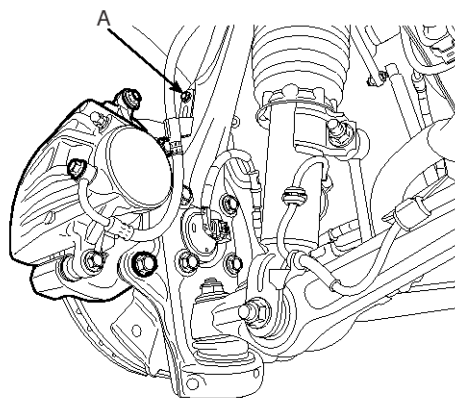


SBHBR8328D

Replacement

Front Brake Pads

1. Remove the brake hose mounting bracket (knuckle mounting part : A).

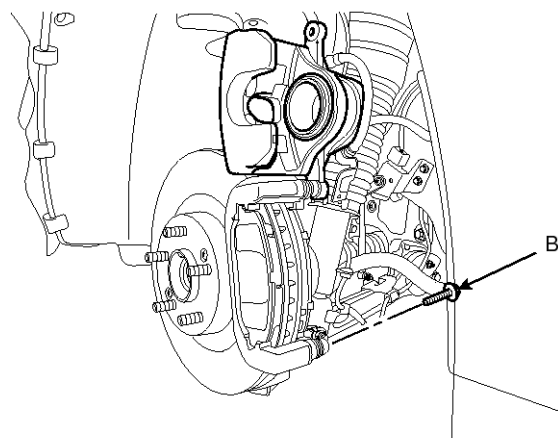


SBHBR9301L

2. Loosen the guide rod bolt (B) and pivot the caliper up out of the way.

Tightening torque :

21.6 ~ 31.4N.m (2.2 ~ 3.2kgf.m, 15.9 ~ 23.1lb-ft)

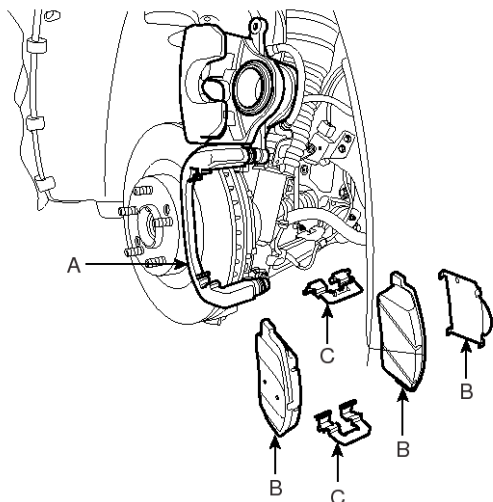


SBHBR8329D

BR-26

Brake System

3. Replace pad shim (B), pad retainers (C) and brake pads (B) in the caliper bracket (A).



SBHBR8330D

Inspection

Front Brake Disc Thickness Check

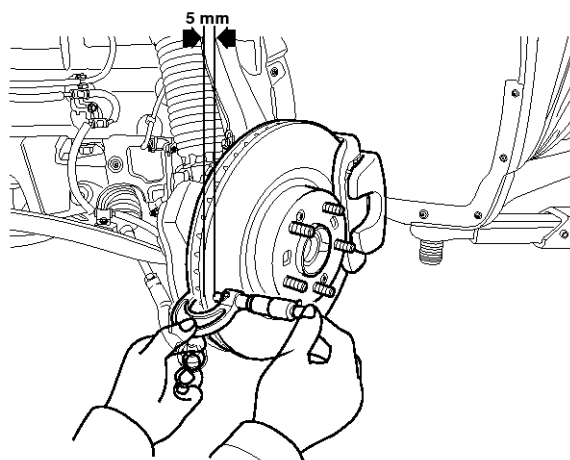
1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

Brake disc thickness

Standard: 28mm (1.10in)

Service limit: 26.4mm (1.04in)

Deviation: Less than 0.005mm (0.0002in)



SBHBR8331D

4. If wear exceeds the limit, replace the discs and pad assembly left and right of the vehicle.

Brake System

BR-27

Front Brake Pad Check

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

Pad thickness

Standard value : 10.5mm (0.413in)

Service limit : 2.0mm (0.0787in)

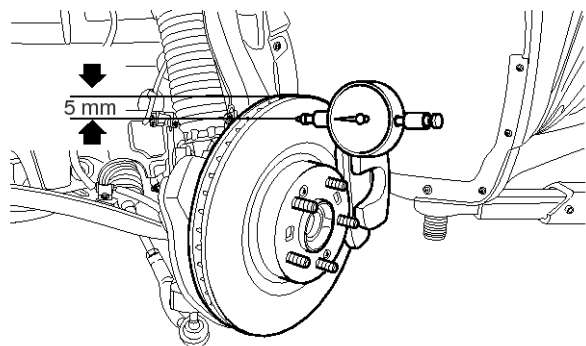
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

Front Brake Disc Runout Check

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

Brake disc runout

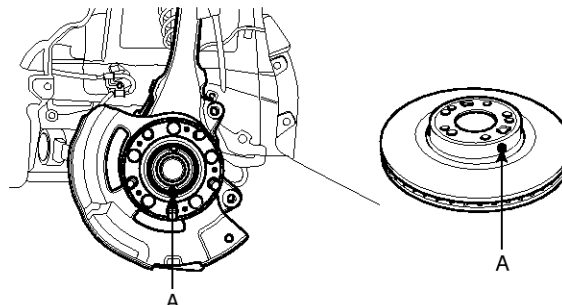
Limit : 0.03mm (0.00118in.) or less (new one)



SBHBR8332D

2. If the runout of the brake disc exceeds the limit specification, reinstall the disc after turning the disc 72° clockwise. Recheck the runout. If the runout exceeds the specification, try turning the disc by 72° and recheck the runout until a full revolution (360°, 4 steps).
3. If the runout cannot be corrected by turning the disc, replace the brake disc.

4. When installing brake disc, runout peak point markings(A) on disc and hub must be as close as possible(within 72° range).



SBHBR9332L

5. After installing the new disc repeat above procedure 1~4 again.

Installation

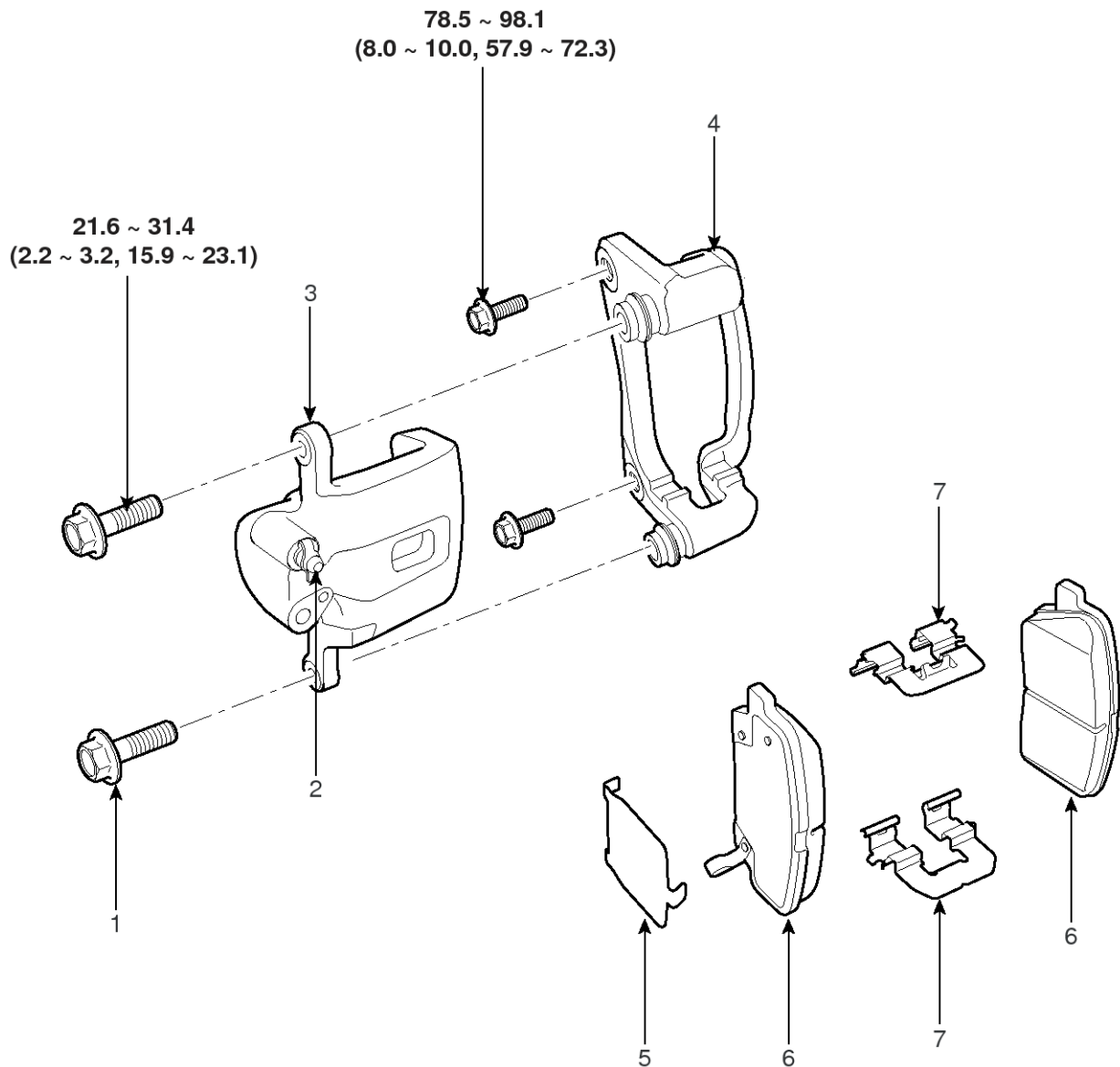
1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system. (Refer to Brake system bleeding)

BR-28

Brake System

Rear Disc Brake

Components



Torque : N.m (kgf.m, lb-ft)

SBHBR9330L

1. Guide rod bolt
2. Bleed screw
3. Caliper bracket
4. Caliper body

5. Inner pad shim
6. Brake pad
7. Pad retainer

Brake System

BR-29

Removal

1. Remove the rear wheel & tire.

Tightening torque :

88.3 ~ 107.9N.m (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)

2. Loosen the hose eye-bolt (B) and caliper mounting bolts (C), then remove the rear caliper assembly (A).

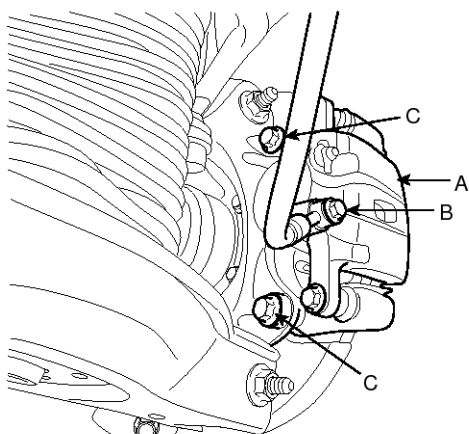
Tightening torque

Brake hose to caliper:

24.5 ~ 29.4N.m (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)

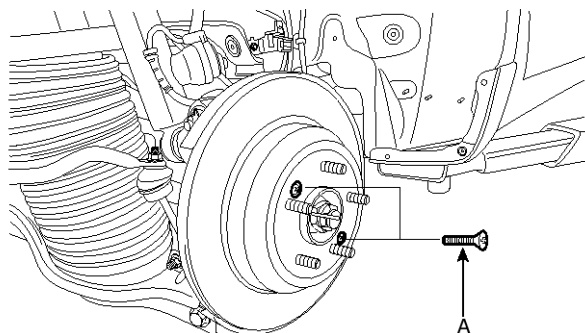
Caliper assembly to carrier:

78.5 ~ 98.1N.m (8.0 ~ 10.0kgf.m, 57.9 ~ 72.3lb-ft)



SBHBR8334D

3. Remove the rear brake disc by loosening the screws (A).



SBHBR8335D

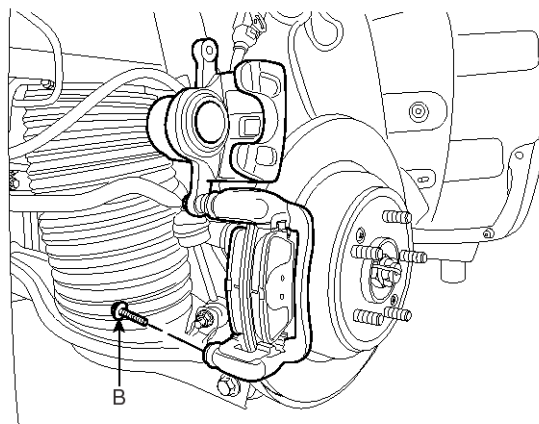
Replacement

Rear Brake Pads

1. Loosen the guide rod bolt (B) and pivot the the caliper up out of the way.

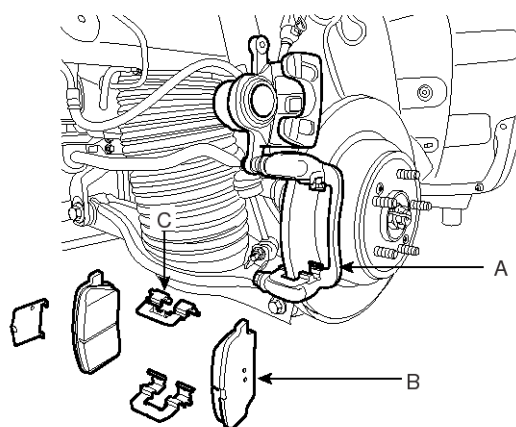
Tightening torque :

21.6 ~ 31.4N.m (2.2 ~ 3.2kgf.m, 15.9 ~ 23.1lb-ft)



SBHBR8336D

2. Replace pad shim, pad retainers (C) and brake pads (B) in the caliper bracket (A).



SBHBR8337D

BR-30

Brake System

Inspection

Rear Brake Disc Thickness Check

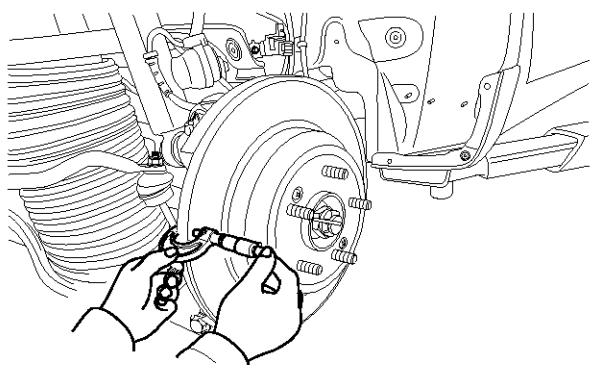
1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

Brake disc thickness

Standard: 13mm (0.51in)

Service limit: 11.4mm (0.45in)

Deviation: less than 0.01mm (0.00039in)



SBHBR9302L

4. If wear exceeds the limit, replace the discs and pad assembly left and right of the vehicle.

Rear Brake Pad Check

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

Pad thickness

Standard value: 10mm (0.393in)

Service limit: 2.0 mm (0.0787 in)

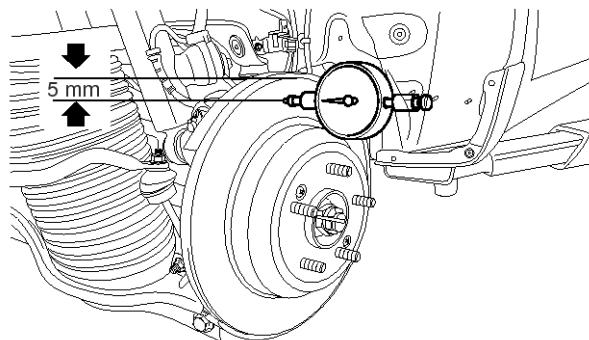
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

Rear Brake Disc Runout Check

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

Brake disc runout

Limit: 0.03mm (0.00118in.) or less (new one)



SBHBR8339D

2. If the runout of the brake disc exceeds the limit specification, replace the disc, and then measure the runout again.
3. If the runout exceeds the limit specification, install the brake disc after turning it 180° and then check the runout of the brake disc again.
4. If the runout cannot be corrected by changing the position of the brake disc, replace the brake disc.

Installation

1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system. (Refer to Brake system bleeding)

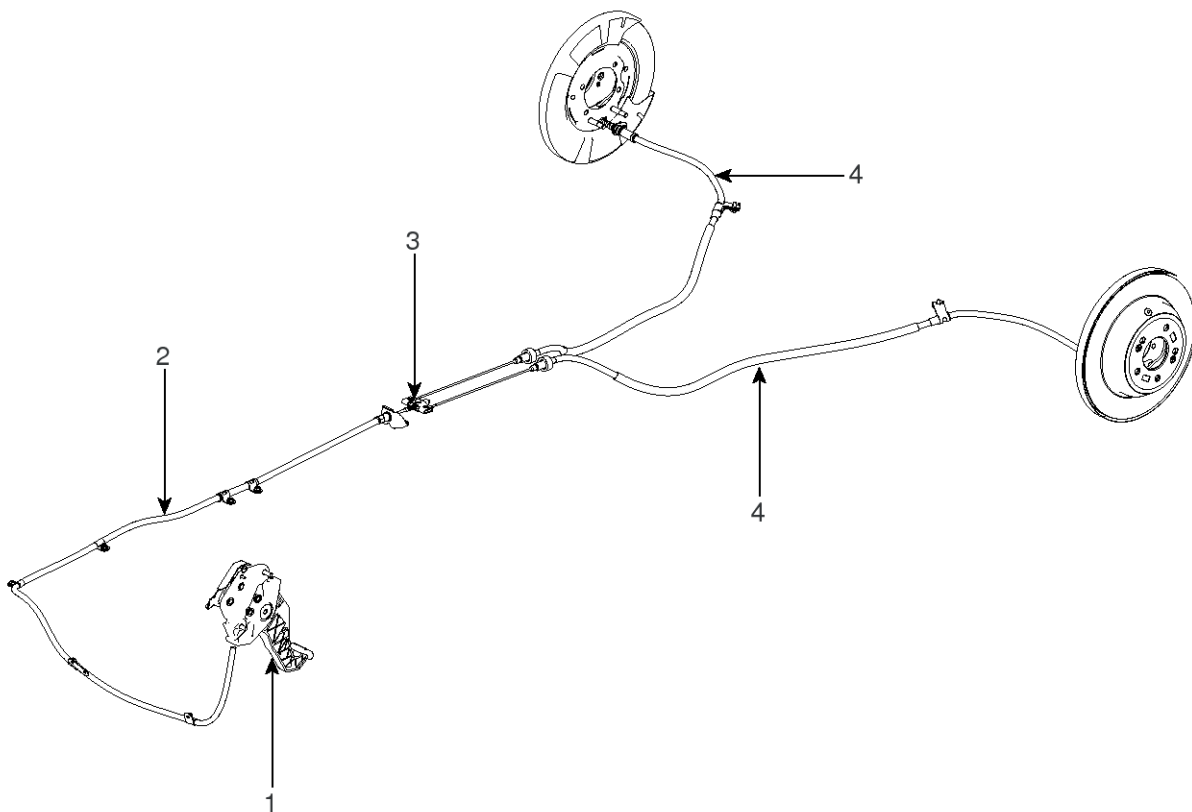
Parking Brake System

BR-31

Parking Brake System

Parking Brake Assembly

Components (1)



SBHBR8340D

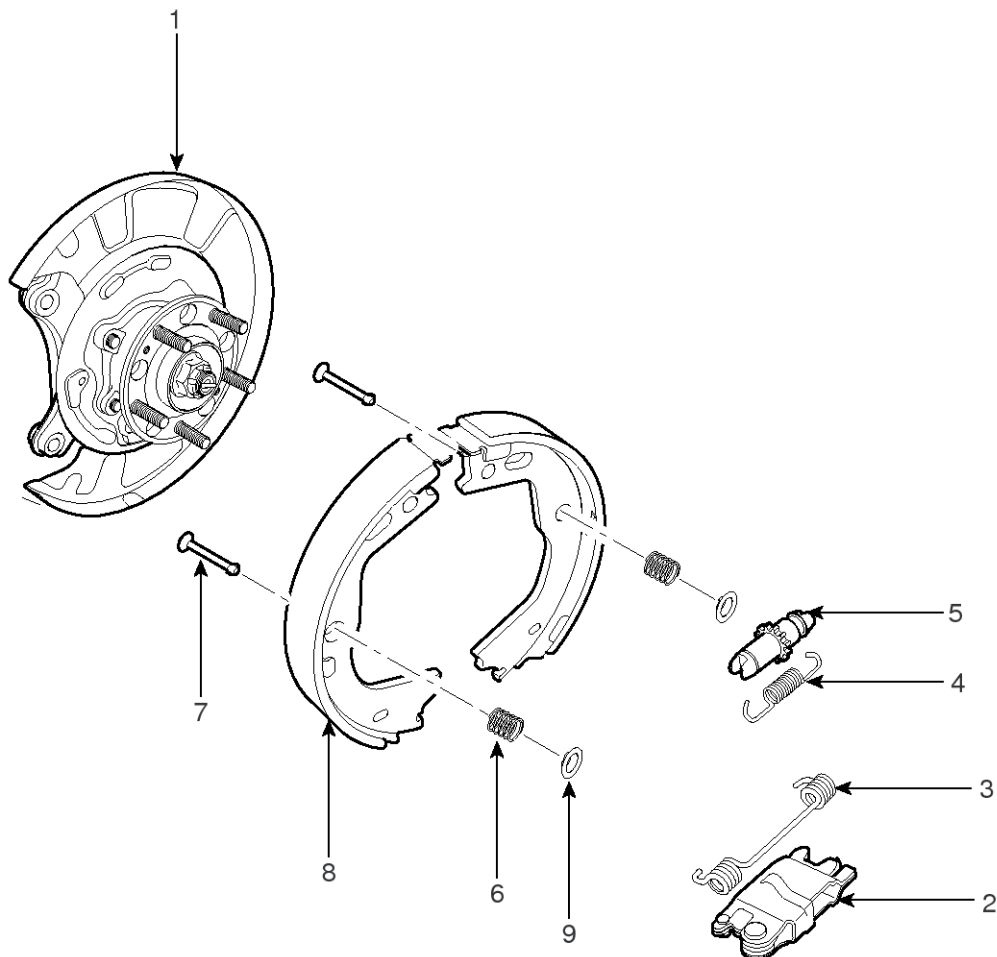
- 1. Parking brake pedal
- 2. Front parking brake cable

- 3. Equalizer assembly
- 4. Rear parking brake cable

BR-32

Brake System

Components (2)



SBHBR8341D

- 1. Backing plate
- 2. Operating lever
- 3. Upper spring

- 4. Lower spring
- 5. Adjuster
- 6. Shoe hold down spring

- 7. Shoe hold down pin
- 8. Parking brake shoe
- 9. Cup washer

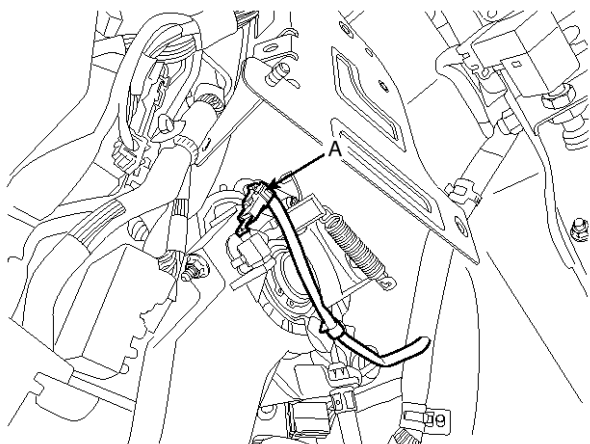
Parking Brake System

BR-33

Removal

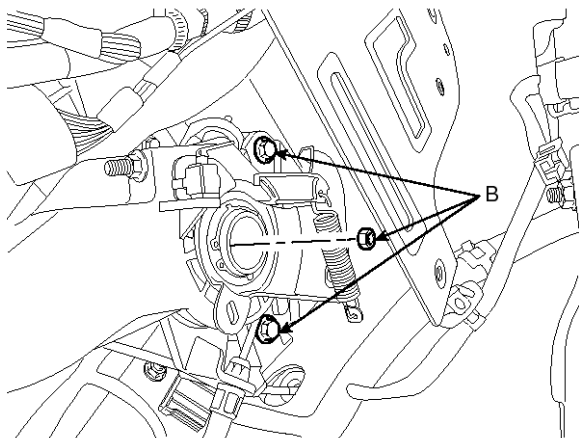
Parking Brake Pedal

1. Remove the crash pad lower panel. (Refer to the Body group-crash pad)
2. Remove the IPM after removing the nut and connector. (Refer to the Body Electrical System group-BCM)
3. Disconnect the parking brake switch connector (A).



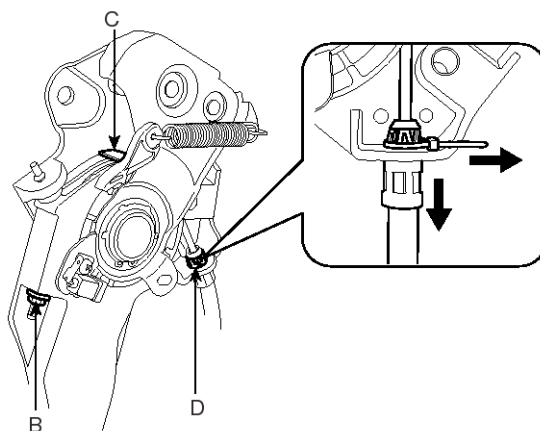
SBHBR8342D

4. Remove the parking brake pedal mounting bolts and nut (B), then remove the parking brake pedal.



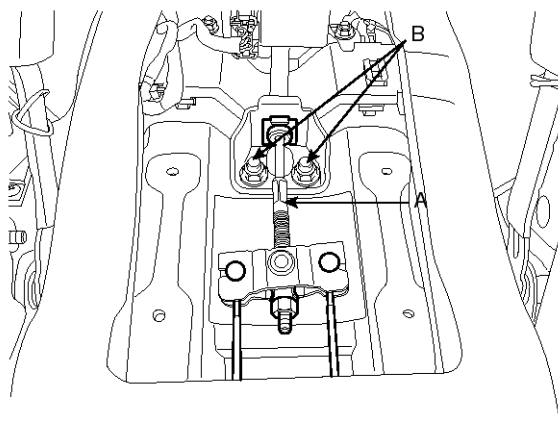
SBHBR9323L

5. Remove the cable adjust nut (B) and cable guide (C). And then detach the parking brake cable after tightening the fixing clip (D) with cable tie.



SBHBR8416D

6. Remove the floor console. (Refer to the Body group-Console).
7. Remove the crash pad and cowl cross bar assembly. (Refer to Body group-Crash pad)
8. Remove the heater & blower unit. (Refer to heater group- heater unit)
9. Loosen the cable fixing nut (B) and detach the rear parking brake cable which connected equalizer. And then remove front parking brake cable (A).



SBHBR8417D

BR-34

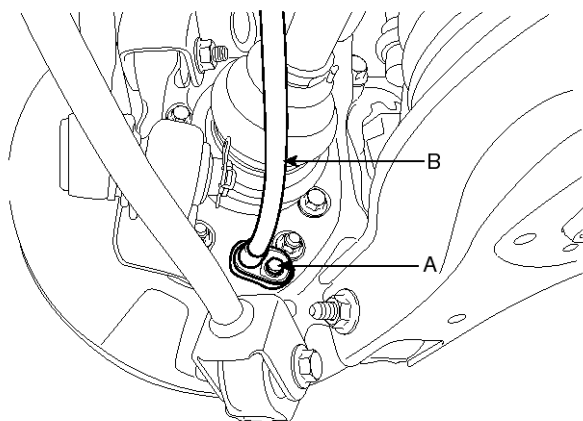
Brake System

Parking Brake Shoe

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the brake caliper and Rear disc brake. (Refer to "Rear disc brake removal")
4. Remove the parking brake cable (B), after removing the bolt (A).

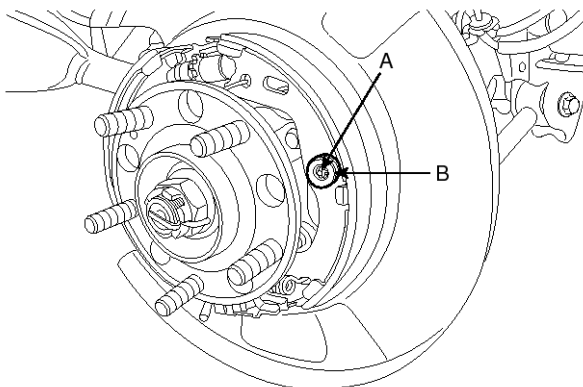
Tightening torque :

6.9 ~ 10.8N.m (0.7 ~ 1.1kgf.m, 5.1 ~ 8.0lb-ft)



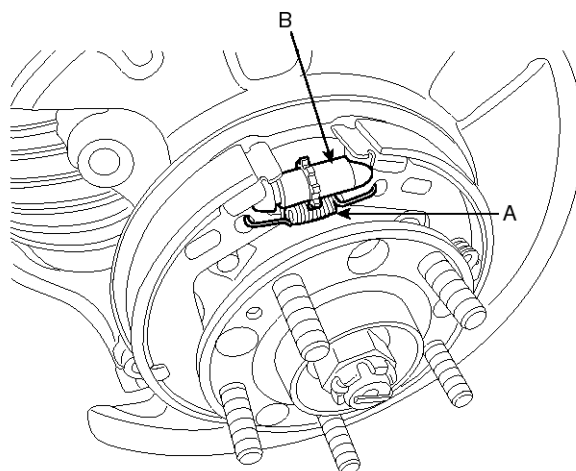
SBHBR8346D

5. Remove the shoe hold down pin (A) and the spring (B) by pushing the retainer spring and turning the pin.



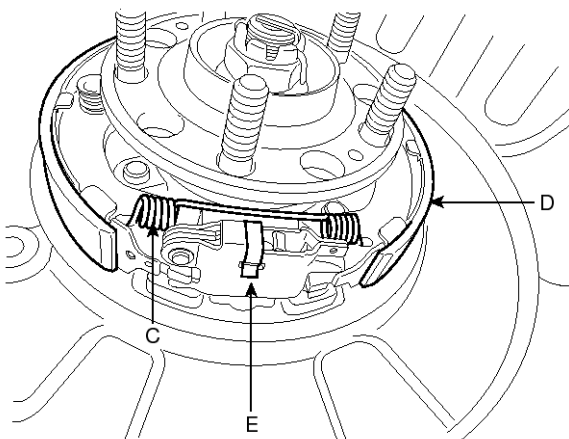
SBHBR8347D

6. Remove the adjuster assembly (B) and the lower return spring (A).



SBHBR8348D

7. Remove the upper return spring (C) and the brake shoes (D).



SBHBR8349D

8. Remove the operating lever assembly (E).

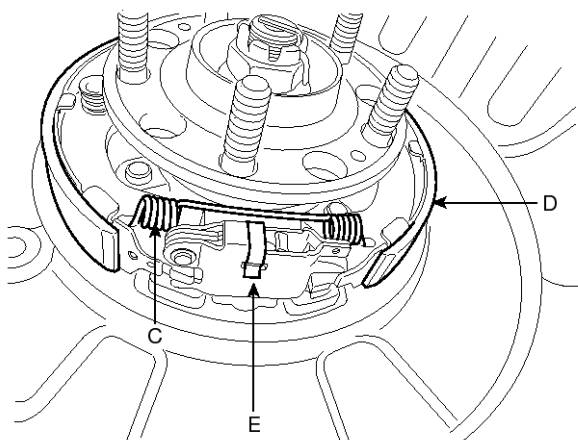
Parking Brake System

BR-35

Installation

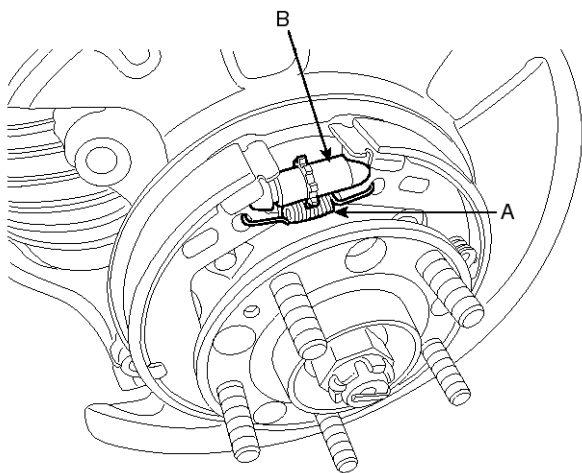
Parking Brake Shoe

1. Install the operating lever assembly (E).



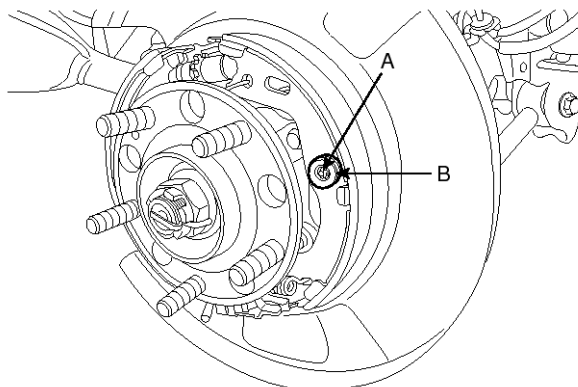
SBHBR8349D

2. Install the upper return spring (C) and the brake shoes (D).
3. Install the adjuster assembly (B) and the lower return spring (A).



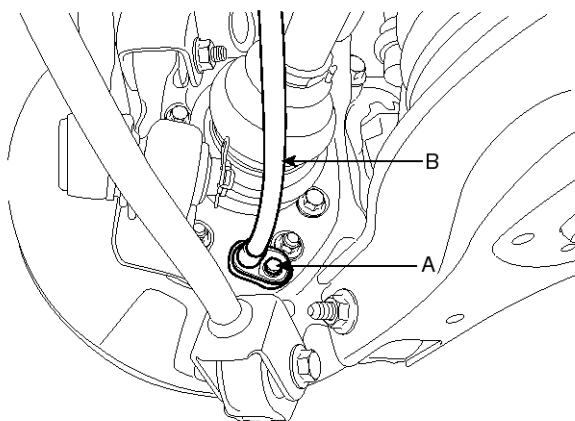
SBHBR8348D

4. While pressing the spring, install the brake shoe hold down pin (A) and spring (B).



SBHBR8347D

5. Install the parking brake cable (B), then install the bolt (A).



SBHBR8346D

NOTICE

How to install the DIH cable (Quick Fit type)

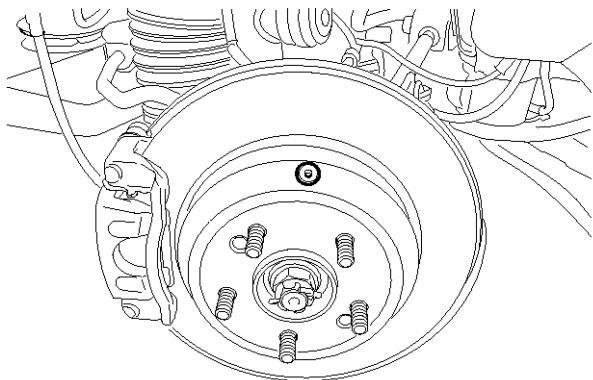
1. Put the inner cable into the knuckle hole in DIH lever operating direction when installing the cable (B).
2. Confirm by pulling the cable that cable is fixed certainly before installing the bolt (A).

BR-36

Brake System

6. Install the rear brake disc, then adjust the rear brake shoe clearance.

- 1) Remove the plug from the disc.



SBHBR8354D

- 2) Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 5 notches in the opposite direction.
7. Install the brake caliper assembly. (Refer to "Rear brake installation")
8. Install the tire and wheel.
9. If the parking brake shoe or the brake disc are replaced a newly one, perform the brake shoe bed-in procedure.
 - 1) While operating the parking brake pedal for 147N (15kgf, 33lbf) effort, drive the vehicle 500 meters (0.31 miles) at the speed of 60kph (37.3 mph).
 - 2) Repeat the above procedure more than two times.
 - 3) Must be held on at 30% uphill.

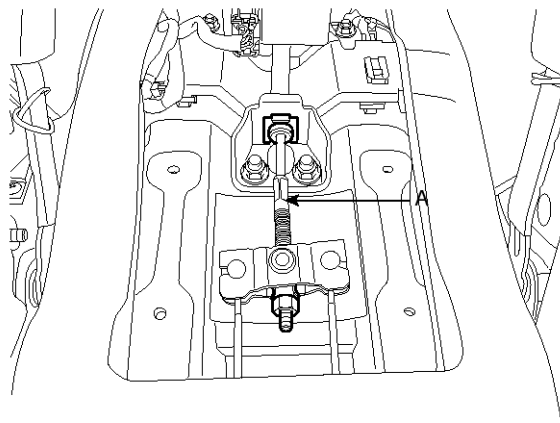
⚠ CAUTION

After adjusting parking brake, notice following matter;

1. Must be free from troubles when the parking pedal is operated at 981 N (100 kgf, 220 lb).
2. Check that all parts move smoothly.
3. The parking brake indicator lamp must be on after the parking pedal is worked and must be off after the pedal is released.

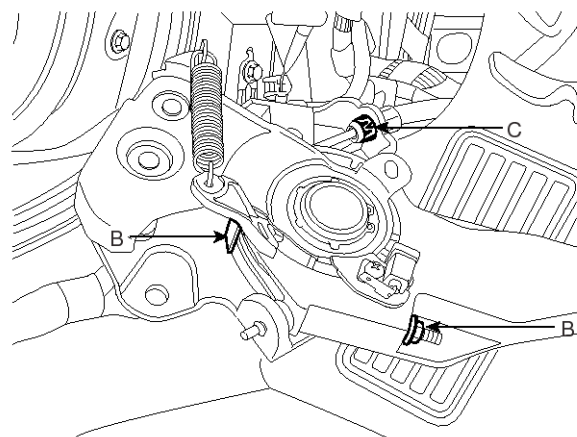
Parking Brake Pedal

1. Install the parking brake cable (A).



SBHBR8345D

2. Install the fixing clip (C), washer plain (D) and cable adjusting nut (B) after fixing the parking brake cable.

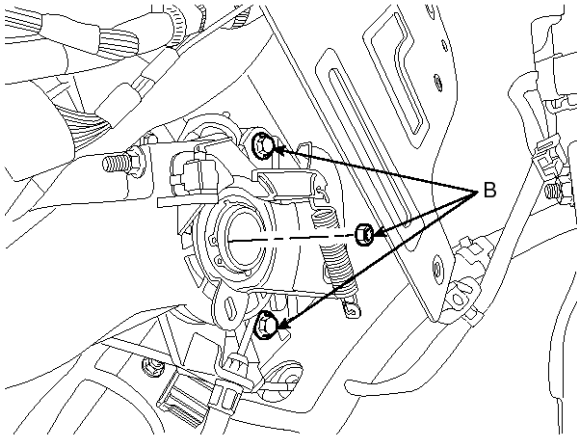


SBHBR8344D

Parking Brake System

BR-37

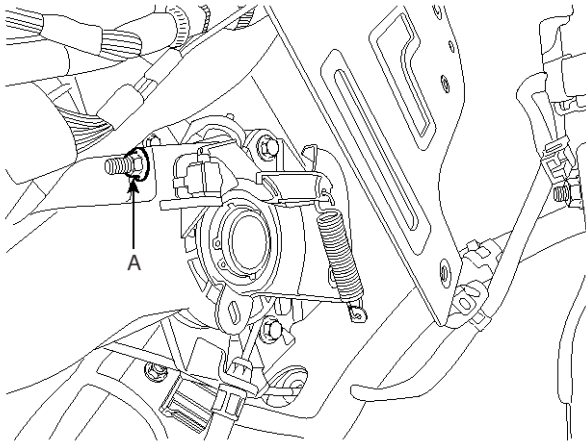
3. Install the parking brake pedal, and then install the parking brake pedal mounting bolts and nut (B).



SBHBR9323L

4. Adjust the parking brake pedal stroke by turning the adjusting nut(A).

- 1) Adjust the adjusting nut (A) so that parking brake pedal stroke is to be between 3 notches when operating effort is 196 N (20 kg.f, 44 lb) after full stroke operation of parking brake pedal over 3 times for setting parking wire.

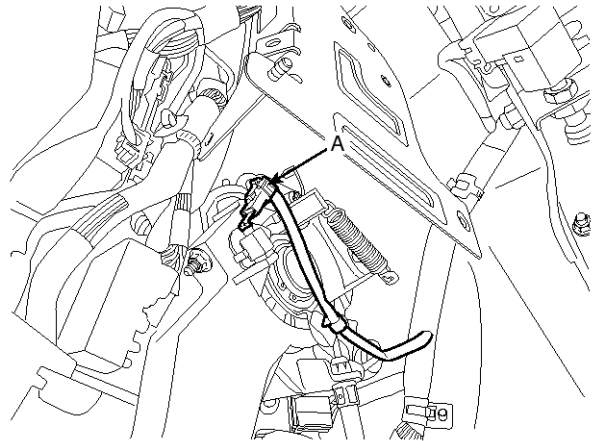


SBHBR8358D

⚠ CAUTION

1. The parking brake adjustment must be carried out after adjusting the rear shoe.
2. After adjusting parking brake, notice following matter.
 - a. Must be free from clearance between adjusting nut and pin.
 - b. Check securely that the brake is not dragging.

5. Reconnect the parking brake switch connector(A).



SBHBR8342D

6. Install the heater & blower unit. (Refer to heater group- heater unit)
7. Install the crash pad and cowl cross bar assembly. (Refer to Body group-Crash pad)
8. Install the floor console. (Refer to the Body group-Console).

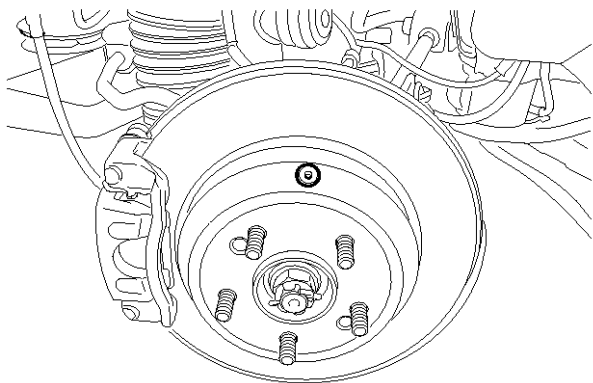
BR-38

Brake System

Adjustment

Parking Brake Shoe Clearance Adjustment

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the plug from the disc.

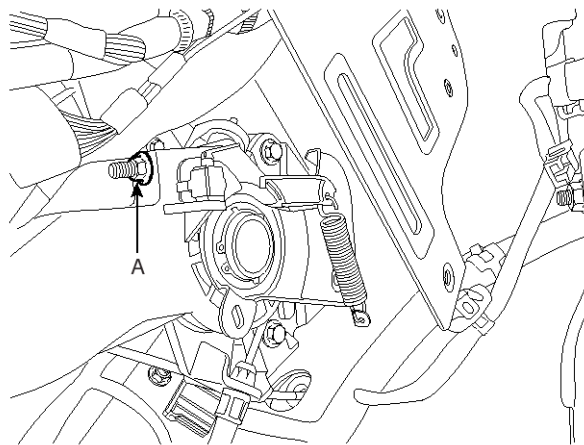


SBHBR8354D

4. Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 5 notches in the opposite direction.
5. Install the plug on disc and then rear wheel & tire.

Parking Brake Pedal Stroke Adjustment

1. Adjust the adjusting nut (A) so that parking brake pedal stroke is to be between 3 notches when operating effort is 196 N (20 kg.f, 44 lb) after full stroke operation of parking brake pedal over 3 times for setting parking wire.



SBHBR8358D

CAUTION

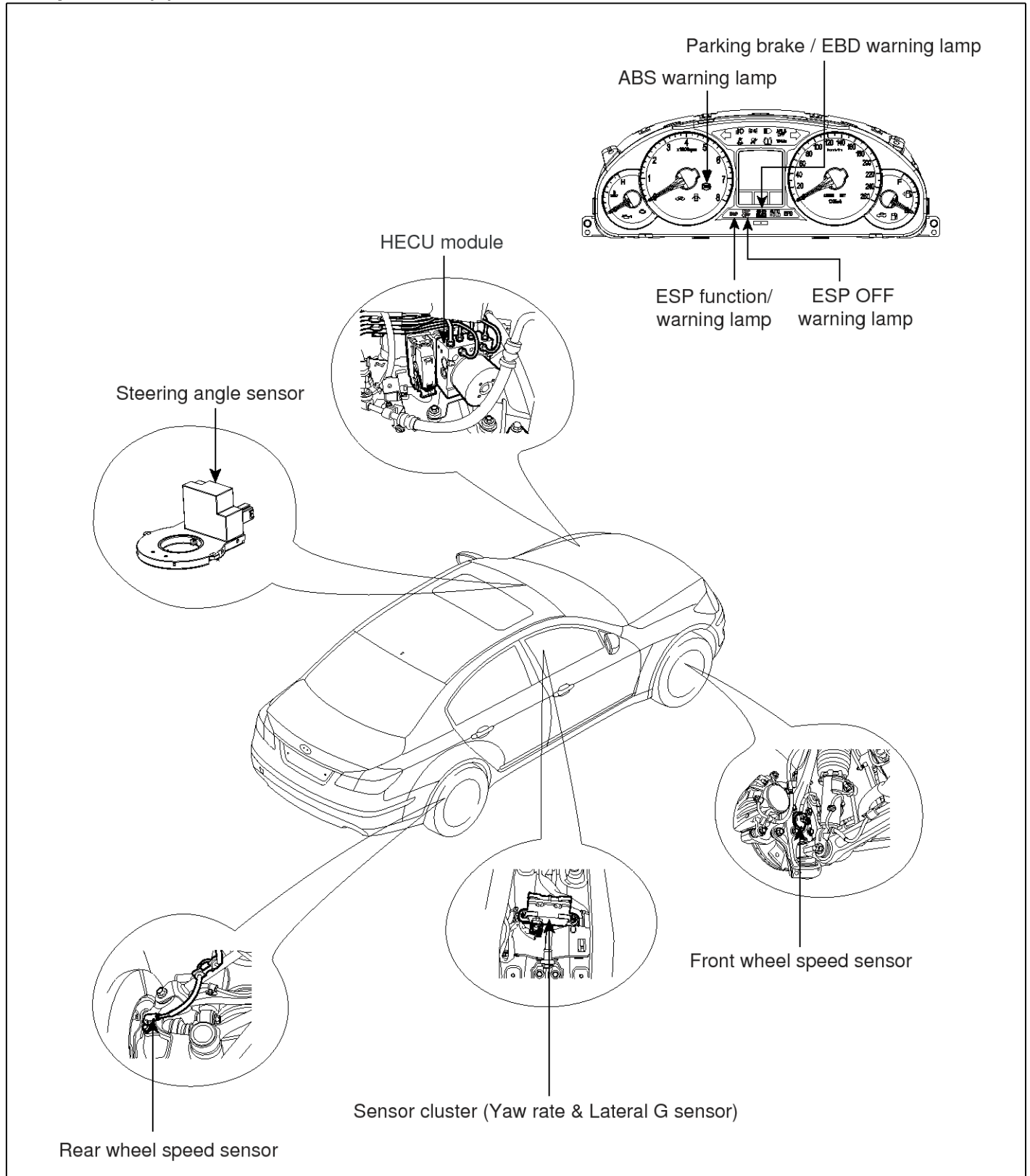
1. The parking brake adjustment must be carried out after adjusting the rear shoe.
2. After adjusting parking brake, notice following matter.
 - a. Must be free from clearance between adjusting nut and pin.
 - b. Check securely that the brake is not dragging.

ESP(Electronic Stability Program) System

BR-39

ESP(Electronic Stability Program) System

Components(1)

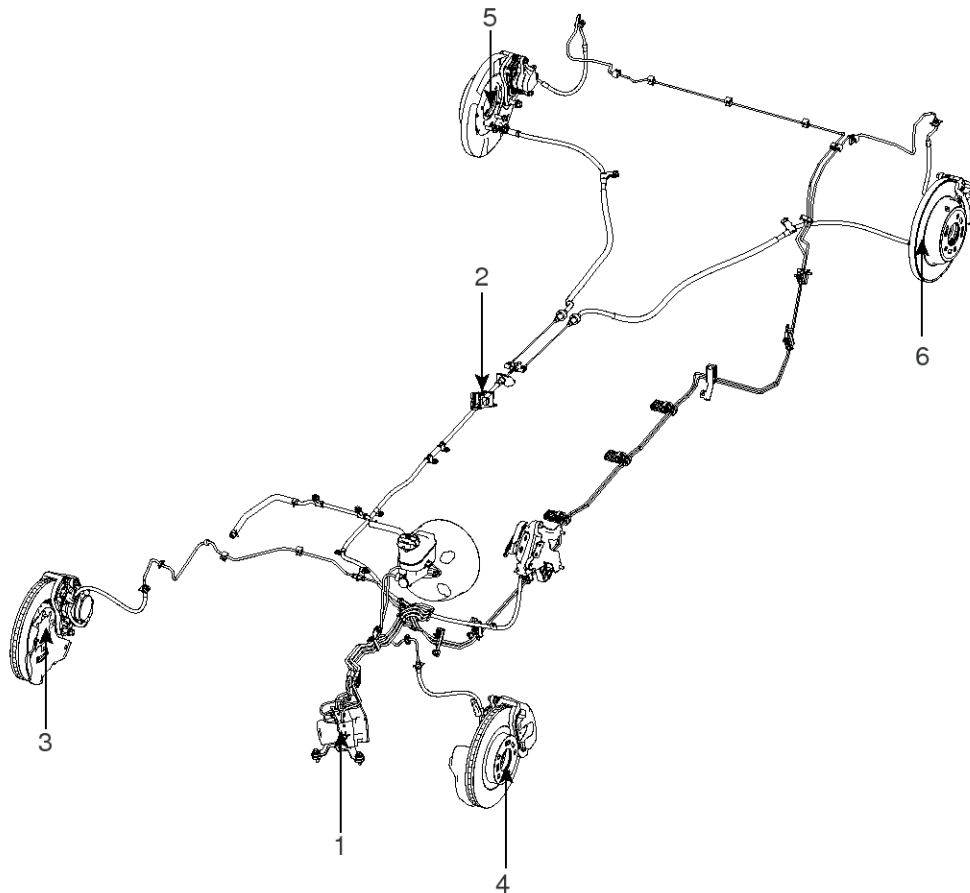


SBHBR9306L

BR-40

Brake System

Components(2)



SBHBR9324L

- | | |
|---|----------------------------------|
| 1. ESP control module (HECU) | 4. Front left wheel speed sensor |
| 2. Sensor cluster (Yaw rate & Lateral G sensor) | 5. Rear right wheel speed sensor |
| 3. Front right wheel speed sensor | 6. Rear left wheel speed sensor |

ESP(Electronic Stability Program) System

BR-41

Description of ESP

Optimum driving safety now has a name: ESP, the Electronic Stability Program.

ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention.

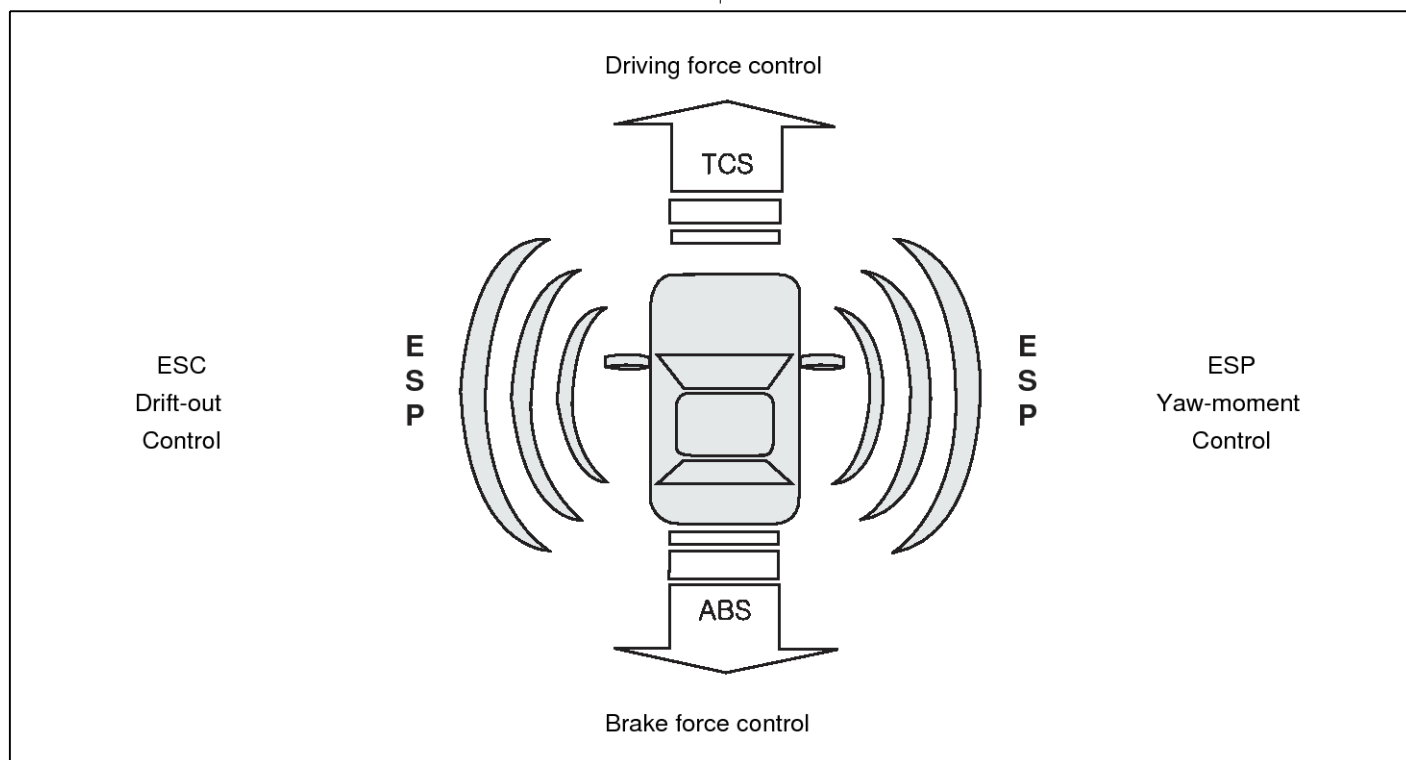
ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and EDC functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about its vertical axis.

This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

ESP essentially consists of three assemblies: the sensors, the electronic control unit and the actuators.

The stability control feature works under all driving and operating conditions. Under certain driving conditions, the ABS/TCS function can be activated simultaneously with the ESP function in response to a command by the driver.

In the event of a failure of the stability control function, the basic safety function, ABS, is still maintained.



SBHBR9319L

BR-42

Brake System

Description of ESP Control

ESP system includes ABS/EBD, TCS and AYC function.

ABS/EBD function The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave.

By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels.

And, the ECU judges whether the ABS/EBD should be actuated or not.

TCS function prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication.

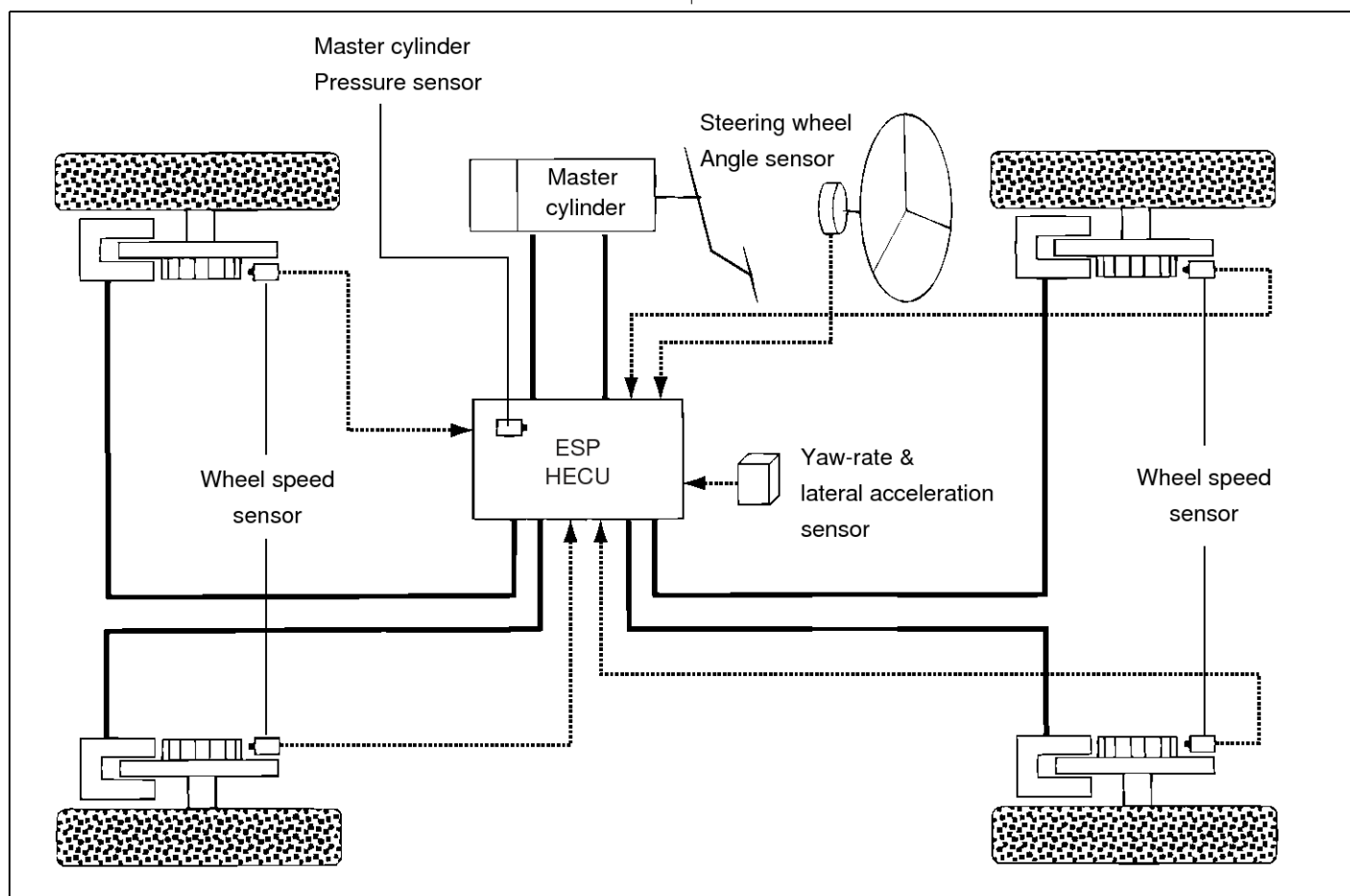
TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals (Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor).

If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake pressure on certain wheel, and send engine torque reduction signal by CAN.

After the key-on, the ECU continually diagnoses the system failure. (Self-diagnosis)

If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)

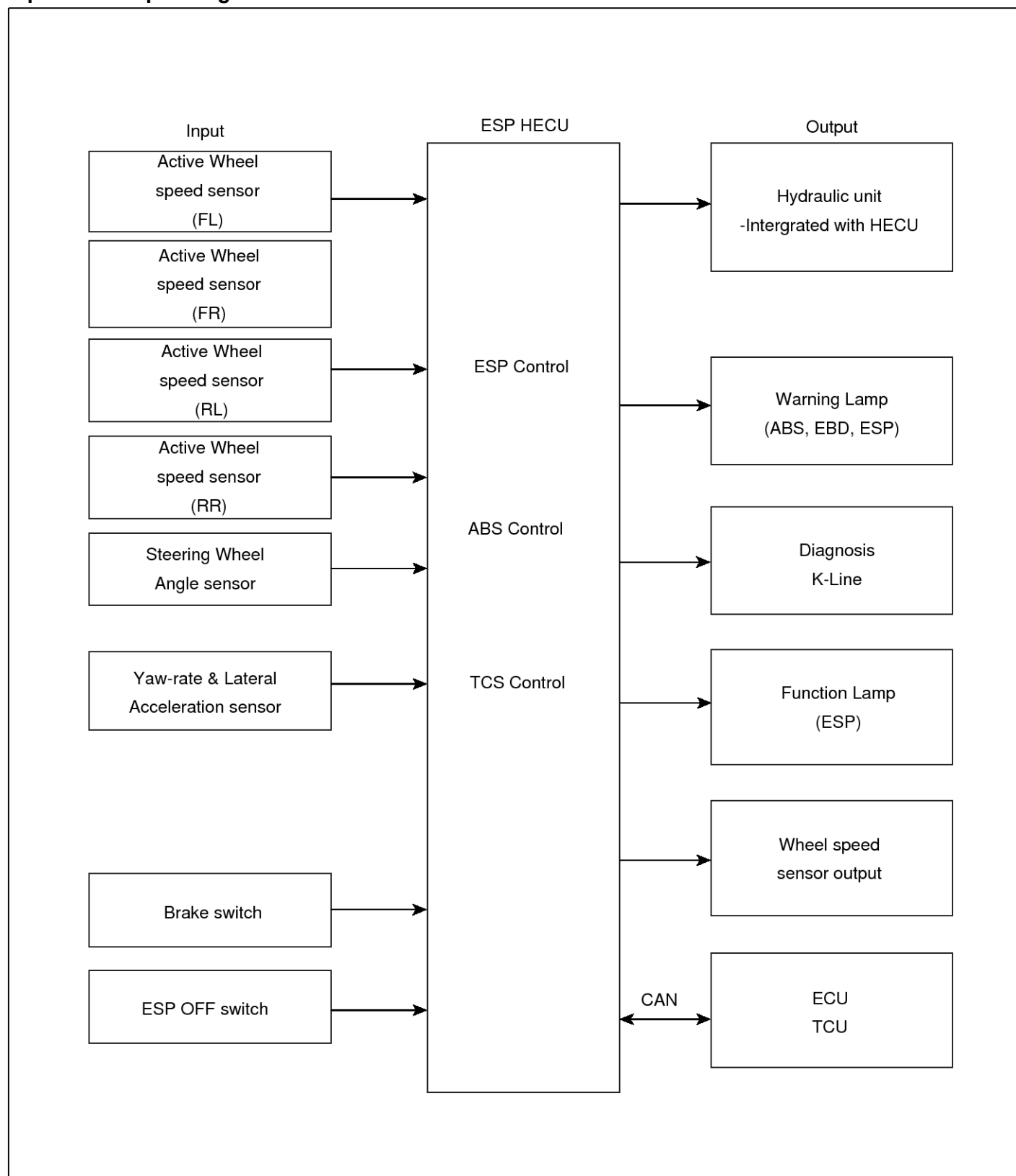


STQBR8328L

ESP(Electronic Stability Program) System

BR-43

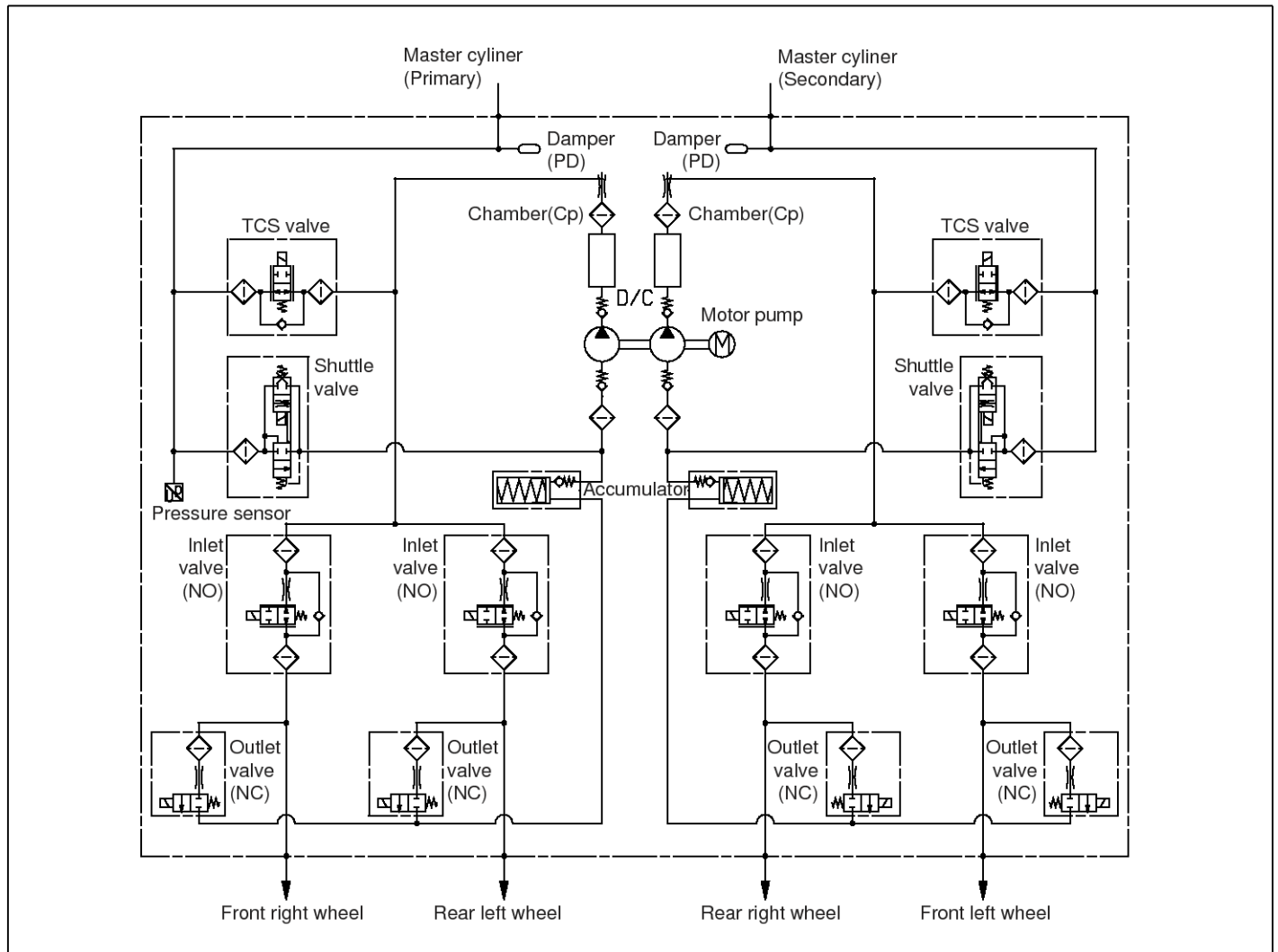
Input and Output Diagram



SBHBR9325L

ESP Operation Mode

ESP Hydraulic System Diagram



SBHBR9307L

ESP(Electronic Stability Program) System

BR-45

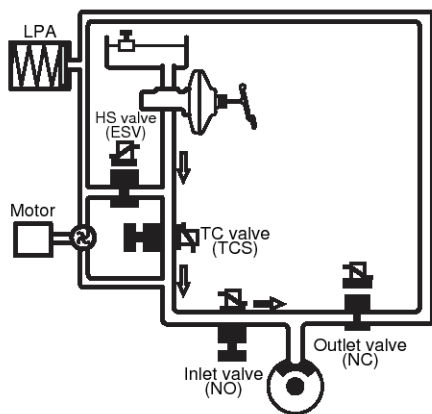
1. ESP Non-operation : Normal braking.

Solenoid valve	Continuity	Valve	Motor pump	TC Valve
IN (NO)	OFF	OPEN	OFF	OFF
OUT (NC)	OFF	CLOSE		

Operation

In this position, the inlet valve and the TCS valve are open, the electrically operated shuttle valve and the outlet valve are closed.

* ESV: Electric reversing valve.



LJCD207A

BR-46

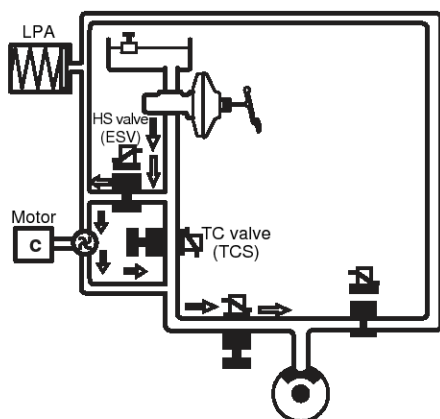
Brake System

2. ESP operation

Solenoid valve		Continuity	Valve	Motor pump	TC Valve
Under steering (Only inside of rear wheel)	IN(NO)	OFF	OPEN	ON	ON
	OUT(NC)	OFF	CLOSE		
Over steering (Only outside of front wheel)	IN(NO)	OFF	OPEN		
	OUT(NC)	OFF	CLOSE		

Operation

The on/off booster builds up a pressure of approx. 10 bar in order to enable the ESP pump to suck brake fluid at low temperatures. In this position, the inlet valve is driven in a pulsed cycle. The TCS valve is closed. The outlet valve remains closed. The electrically operated shuttle valve is opened. The hydraulic pressure is led to the wheel brakes which are to be applied for a brief period of time.



LJCD208A

ESP(Electronic Stability Program) System

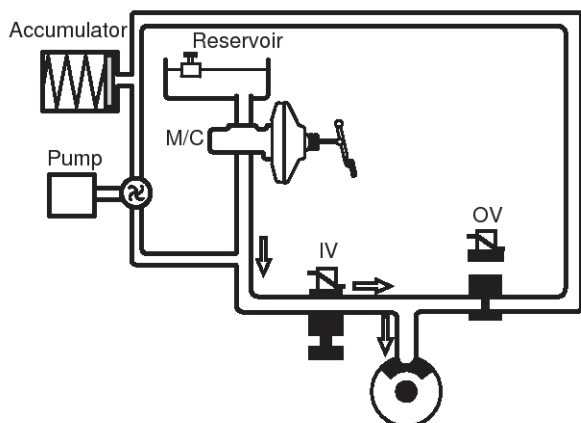
BR-47

ABS Operation Mode

1. Normal Braking

Solenoid valve	State	Valve	Passage
Inlet valve (NO)	OFF	OPEN	Master cylinder⇔Wheel cylinder
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder⇔Reservoir

When braking, the hydraulic pressure in the TMC is increased. The pressure reaches the wheel brake via the current less open inlet valve IV. The current less closed outlet valve OV is closed. For the sake of simplicity the diagram is limited to only the solenoid valve pair of one brake circuit. The wheel speed is reduced as the brake pressure increases, in the extreme case until the wheel locks.



LJCD015A

BR-48

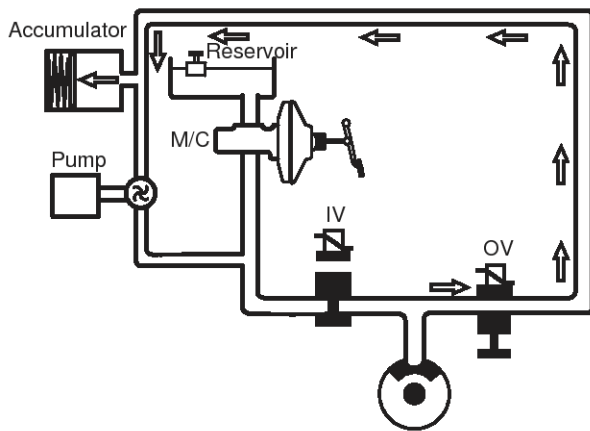
Brake System

2. Dump Mode

Solenoid	State	Valve	Passage
Inlet valve (NO)	ON	CLOSE	Master cylinder ⇄ Wheel cylinder
Outlet valve (NC)	ON	OPEN	Wheel cylinder ⇄ Reservoir

If the wheel speed decreases, there is still a tendency to lock; the brake pressure on the corresponding wheel must be reduced accordingly. For this, the outlet valve OV is opened, the inlet valve IV remains closed.

The brake pressure to the low-pressure accumulator is reduced. The wheel in danger of locking gains speed again.



LJCD016A

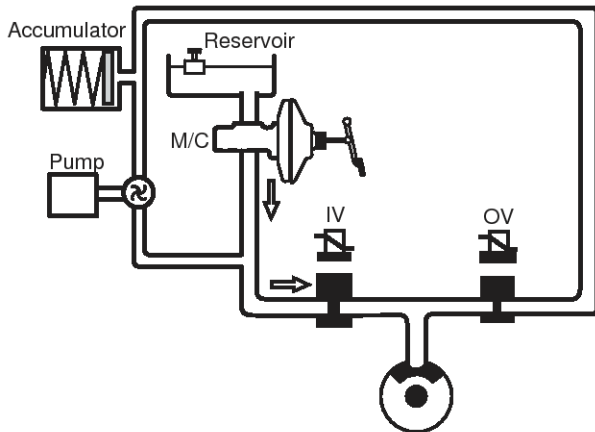
ESP(Electronic Stability Program) System

BR-49

3. Hold Mode

Solenoid	State	Valve	Passage
Inlet valve (NO)	ON	CLOSE	Master cylinder⇌Wheel cylinder
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder⇌Reservoir

When a wheel (or several) tends to lock the inlet valve IV is first closed to avoid a further increase in brake pressure. The outlet valve OV remains closed: the brake pressure is kept constant.



LJCD017A

BR-50

Brake System

4. Increase Mode

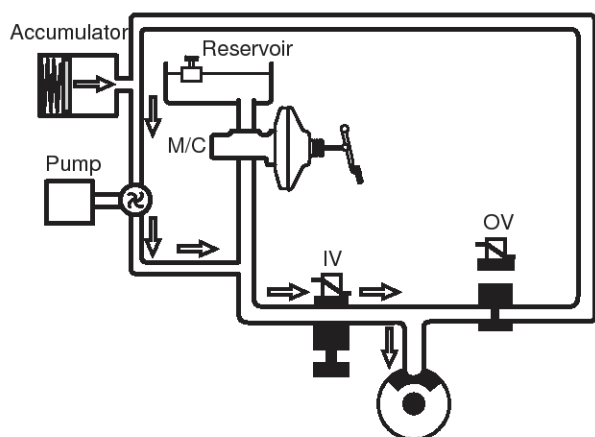
Solenoid	State	Valve	Passage
Inlet valve (NO)	OFF	OPEN	Master cylinder⇌Wheel cylinder
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder⇌Reservoir

For optimum brake from the certain wheel acceleration a brake pressure increase is necessary. For this, the inlet valve IV is opened and the outlet valve OV is closed. The pump of the unit starts to run and aspirates the necessary quantity of fluid from the Low-pressure accumulator, in order to produce the necessary brake pressure for the pressure increase phase in seconds.

With an increase in the brake pressure the wheel speed is reduced. These control phases are repeated until the ABS control unit no longer detects any tendency of the wheels to lock.

NOTICE

During ABS control function, the brake pedal only moves in accordance with the volume requirement of the wheels. Because of a sudden change in friction coefficient this pedal movement may increase slightly.

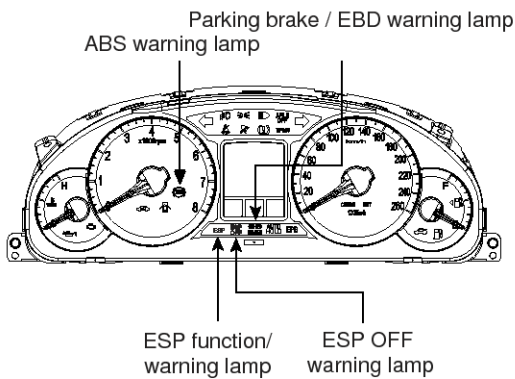


LJCD018A

ESP(Electronic Stability Program) System

BR-51

ABS Warning Lamp Module



SBHBR9308L

ABS Warning Lamp Module

The active ABS warning lamp module indicates the self test and failure status of the ABS .The ABS warning lamp shall be on:

- During the initialization phase after IGN ON.
(Continuously 3 seconds).
- In the event of inhibition of ABS functions by failure.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

EBD/Parking Brake Warning Lamp Module

The active EBD warning lamp module indicates the self test and failure status of the EBD. However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions. The EBD warning lamp shall be on:

- During the initialization phase after IGN ON.
(Continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

ESP Warning Lamp (ESP System)

The ESP warning lamp indicates the self test and failure status of the ESP.

The ESP warning lamp is turned on under the following conditions:

- During the initialization phase after IGN ON.
(Continuously 3 seconds).
- In the event of inhibition of ESP functions by failure.
- During diagnostic mode.

ESP Function Lamp (ESP System)

The ESP function lamp indicates the self-test and operating status of the ESP.

The ESP Function lamp operates under the following conditions:

- During the initialization phase after IGN ON.
(Continuously 3 seconds).
- When the ESP control is operating. (Blinking - 2Hz)

ESP ON/OFF Switch (ESP System)

The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input. The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition.

Initial status of the ESP function is on and switch toggle the state.

EBD (Electronic Brake-Force Distribution) Operation

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the effective adhesion utilization by the rear wheels.

It further utilizes the efficiency of highly developed ABS equipment by controlling the slip of the rear wheels in the partial braking range.

The brake force is moved even closer to the optimum and controlled electronically, thus dispensing with the need for the proportioning valve.

The proportioning valve, because of a mechanical device, has limitations to achieve an ideal brake force distribution to the rear wheels as well as to carry out the flexible brake force distribution proportioning to the vehicle load or weight increasing. And in the event of malfunctioning, driver cannot notice whether it fails or not.

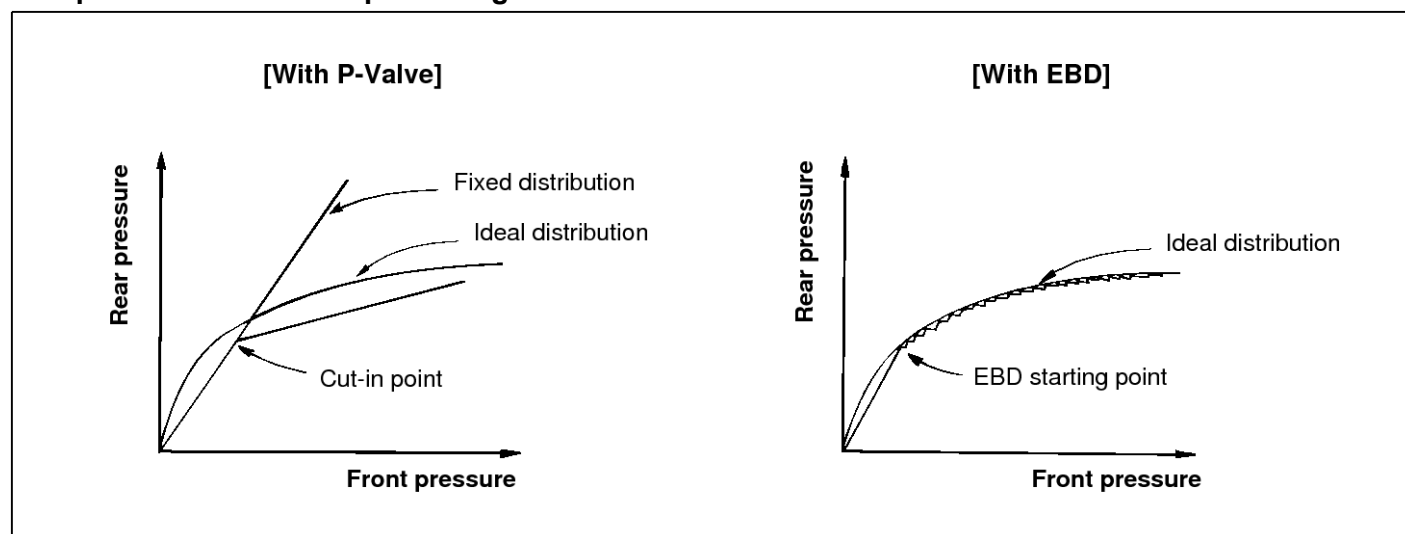
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

Advantages

- Function improvement of the base-brake system.
- Compensation for the different friction coefficients.
- Elimination of the proportioning valve.
- Failure recognition by the warning lamp.

Comparison between Proportioning Valve and EBD

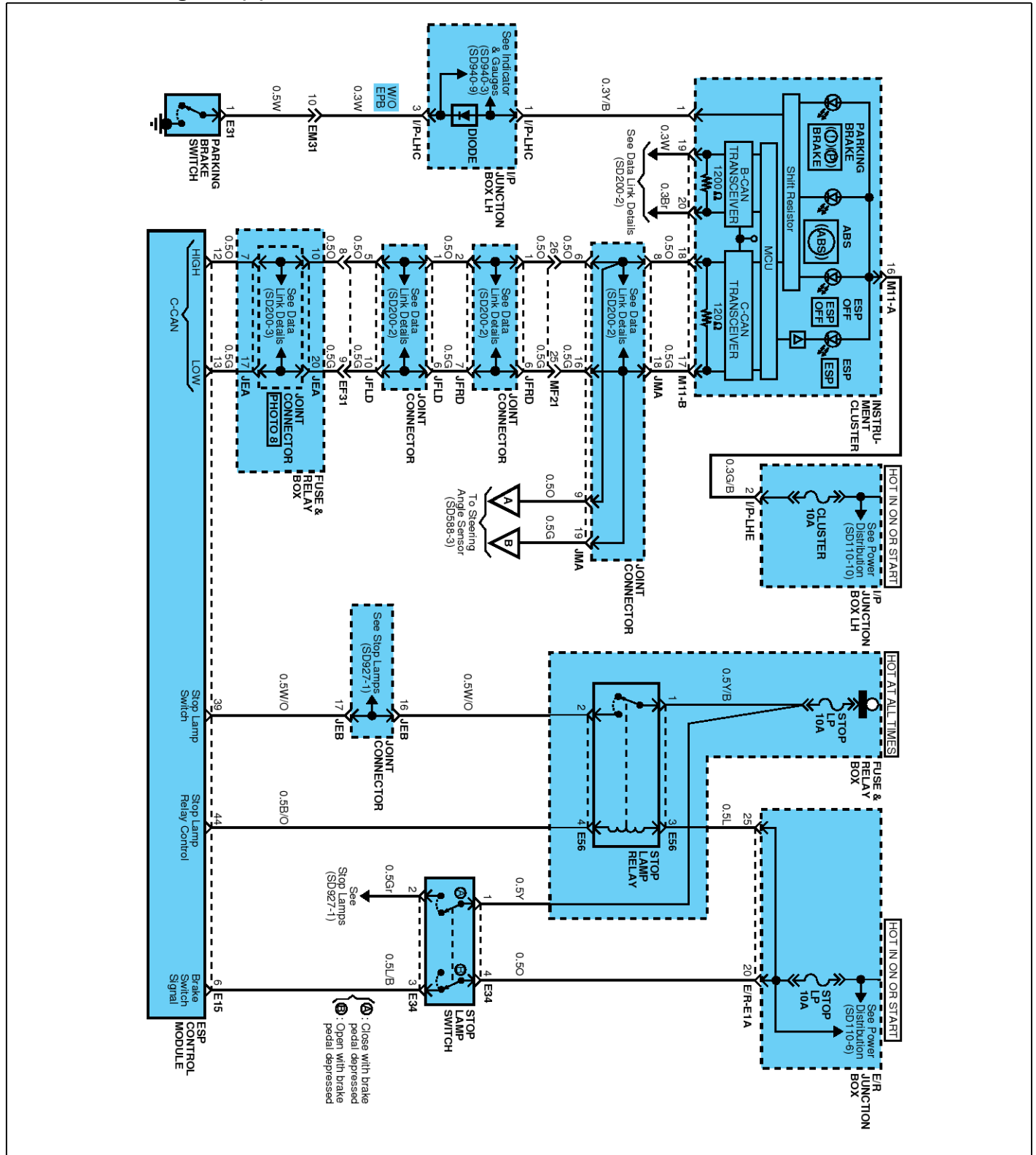


EJA0032A

ESP(Electronic Stability Program) System

BR-53

ESP Circuit Diagram (1)



SBHBR9309L

The diagram illustrates the electrical connections for the ESP Control Module. It includes the following components and connections:

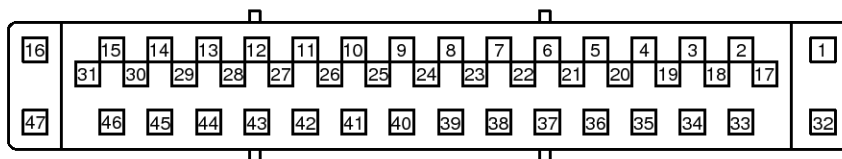
- ESP Control Module:** The central unit with pins 16, 2.0B, 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5.
- EPB Switch:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Auto Parking Switch:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- EPB & ESP Switch:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Crash Pad Switch:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Wheel Sensor:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- ECM:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- PDM:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- AV Head Module:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Front Wheel Sensor LH:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Front Wheel Sensor RH:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Rear Wheel Sensor LH:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- Rear Wheel Sensor RH:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- ECM:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- PDM:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.
- AV Head Module:** Connected to pins 4.7, 4.6, 4.5, 3.3, 3.4, 3.7, 3.6, 4.2, 4.3, 7, 1.1, 1.6, 1.4, 2.3, and 1.5. It includes a 0.5W/B resistor and a 0.5W resistor.

<https://autolibrary.ir>

BR-56

Brake System

ESP Connector Input/Output



SBHBR8383D

Pin No.	Function	Current(mA)	Voltage range(V)	Remark
1	Battery power	< 30.0A	0 ~ 18	
2	-	-	-	
3	-	-	-	
4	ESP switch	< 10	0 ~ 18	
5	-	-	-	
6	Brake switch	< 10	0 ~ 18	
7	Wheel speed output (RR)	< 20	0 ~ 18	
8	Ignition (+)	< 10	0 ~ 18	
9	Wheel speed output (RL)	< 20	0 ~ 18	
10	Diagnosis (K- Line)	100	0 ~ 18	
11	Wheel speed output (FR)	< 20	0 ~ 18	
12	CAN_Bus line (High)	< 10	0 ~ 18	
13	CAN_Bus line (Low)	< 10	0 ~ 18	
14	Wheel speed output (FL)	< 20	0 ~ 18	
15	-	-	-	
16	Ground	< 20A	0	
17	-	-	-	
18	CAN_Sensor cluster (High)	< 10	0 ~ 18	
19	CAN_Sensor cluster (Low)	< 10	0 ~ 18	
20	-	-	-	
21	-	-	-	
22	Sensor cluster power	< 250	0 ~ 18	
23	-	-	-	
24	-	-	-	
25	-	-	-	
26	-	-	-	

ESP(Electronic Stability Program) System

BR-57

Pin No.	Function	Current(mA)	Voltage range(V)	Remark
27	-	-	-	
28	-	-	-	
29	Sensor cluster Ground	< 250	0	
30	-	-	-	
31	-	-	-	
32	Battery power	< 20A	0 ~ 18	
33	Wheel speed sensor Ground (FR)	3 ~ 45	0	
34	Wheel speed sensor Signal (FR)	3 ~ 45	0 ~ 18	
35	-	-	-	
36	Wheel speed sensor Signal (RL)	3 ~ 45	0 ~ 18	
37	Wheel speed sensor Ground (RL)	3 ~ 45	0	
38	-	-	-	
39	Brake light switch	< 300	0 ~ 18	
40	-	-	-	
41	-	-	-	
42	Wheel speed sensor Ground (RR)	3 ~ 45	0	
43	Wheel speed sensor Signal (RR)	3 ~ 45	0 ~ 18	
44	Brake light output	< 250	0 ~ 18	
45	Wheel speed sensor Signal (FL)	3 ~ 45	0 ~ 18	
46	Wheel speed sensor Ground (FL)	3 ~ 45	0	
47	Ground	< 30A	0	

BR-58

Brake System

Failure Diagnosis

1. In principle, ESP and TCS controls are prohibited in case of ABS failure.
2. When ESP or TCS fails, only the failed system control is prohibited.
3. However, when the solenoid valve relay should be turned off in case of ESP failure, refer to the ABS fail-safe.
4. Information on ABS fail-safe is identical to the fail-safe in systems where ESP is not installed.

Memory of Fail Code

1. It keeps the code as far as the backup lamp power is connected. (O)
2. It keeps the code as far as the HCU power is on. (X)

Failure Checkup

1. Initial checkup is performed immediately after the HECU power on.
2. Valve relay checkup is performed immediately after the IG2 ON.
3. It executes the checkup all the time while the IG2 power is on.
4. Initial checkup is made in the following cases.
 - 1) When the failure is not detected now.
 - 2) When ABS and ESP are not in control.
 - 3) Initial checkup is not made after ECU power on.
 - 4) If the vehicle speed is over 5 mph(8 km/h) when the brake lamp switch is off.
 - 5) When the vehicle speed is over 24.8 mph (40km/h).
5. Though, it keeps on checkup even if the brake lamp switch is on.
6. When performing ABS or ESP control before the initial checkup, stop the initial checkup and wait for the HECU power input again.
7. Judge failure in the following cases.
 - 1) When the power is normal.
 - 2) From the point in which the vehicle speed reaches 4.9 mph (8 km/h) after HECU power on.

Countermeasures in Fail

1. Turn the system down and perform the following actions and wait for HECU power OFF.
2. Turn the valve relay off.
3. Stop the control during the operation and do not execute any until the normal condition recovers.

Warning Lamp ON

1. ABS warning lamp turns on when ABS is fail.
2. ESP operation lamp turns on and ESP OFF warning lamp blinks when ESP is fail.

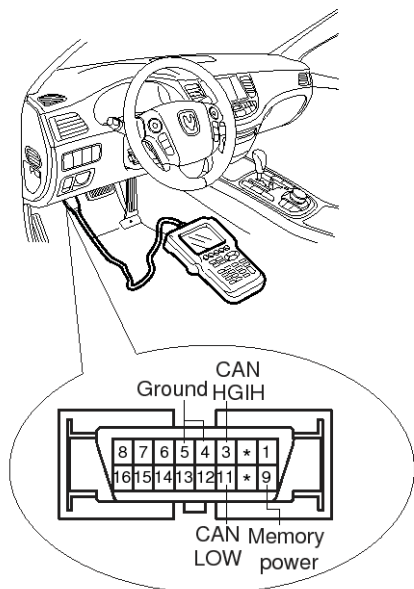
When power voltage and valve relay voltage are abnormal, input/output related failure judgment is not made.

ESP(Electronic Stability Program) System

BR-59

Scan Tool Check

1. Turn the ignition switch OFF.
2. Connector the scan tool to the 16P data link connector located the driver's side kick panel.



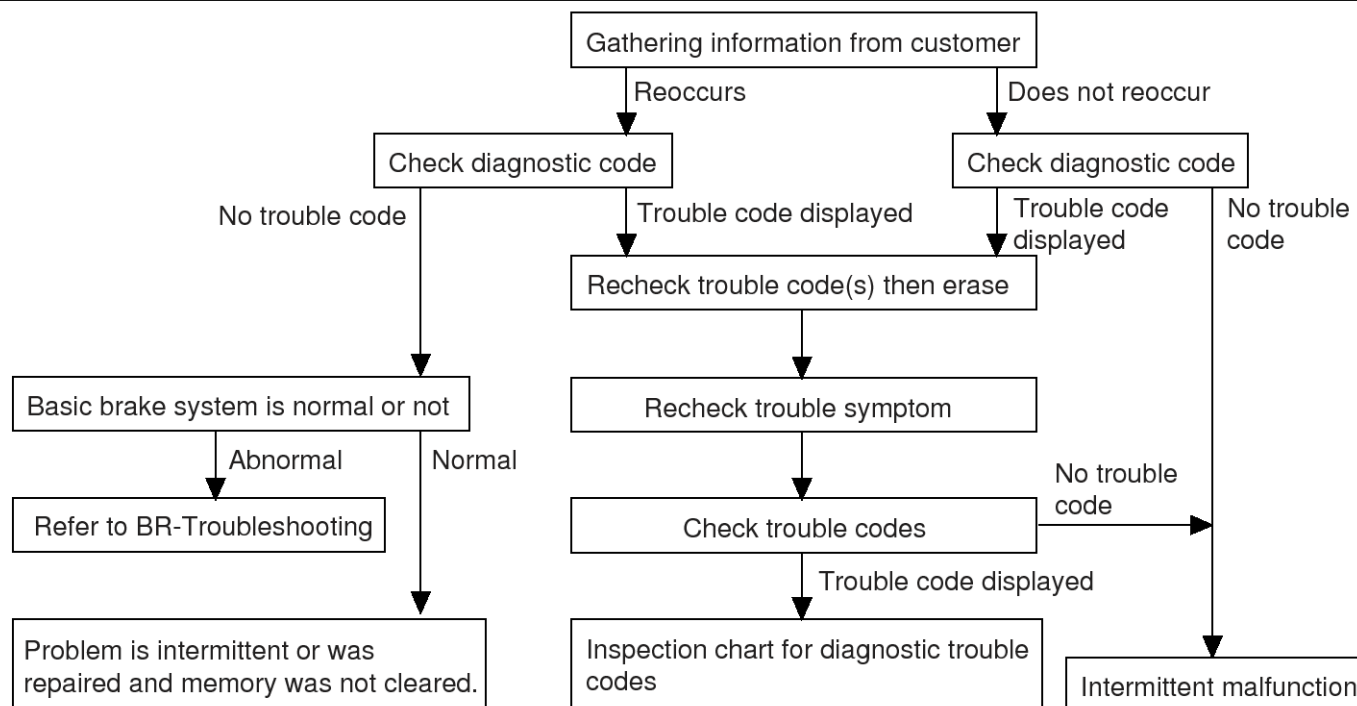
SBHBR9312L

3. Turn the ignition switch ON.
4. Check for diagnostic trouble using the scan tool
5. After completion trouble of the repair or correction of the problem, erase the stored fault codes the clear key on the scan tool.
6. Disconnect the Hi-scan(pro) from the 16P data link connector.

BR-60

Brake System

Standard Flow of Diagnostic Troubleshooting



* Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.

EJKB055A

Notes With Regard To Diagnosis

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.

Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.

ESP(Electronic Stability Program) System

BR-61

ABS Check Sheet

ABS Check Sheet

Inspector's
Name _____

Customer's Name		Registration No.	
		Registration Year	/ /
		VIN.	
Date Vehicle Brought In	/ /	Odometer	Km Miles

Date the Problem First Occurred	/ /
Frequency of Occurrence of Problem	☐ Continuous ☐ Intermittent (times a day)

Symptoms	☐ ABS does not operate.	
	☐ ABS does not operate efficiently.	☐ Intermittent (times a day)
	ABS Warning Light Abnormal	☐ Remains ON ☐ Does not light up

Diagnostic Trouble Code Check	1st Time	☐ Normal Code ☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code ☐ Malfunction Code (Code)

EJDA017A

BR-62

Brake System

Problem Symptoms Table

If a normal code is displayed during the DTC check that the problem still occurs, check the circuits for each problem symptom in the order given in the table below and proceed to the relevant troubleshooting page.

Symptom	Suspect Area	Remarks
ABS does not operate.	Only when 1. -4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit. 4. Check the hydraulic circuit for leakage.	
ABS does not operate intermittently.	Only when 1. -4. are all normal and the problem is still occurring, replace the ABS actuator assembly. 1. Check the DTC reconfirming that the normal code is output. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.	
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line	
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU	
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU	
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU	

CAUTION

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

ESP(Electronic Stability Program) System

BR-63

ABS Does Not Operate.

STQBR8319L

Detecting Condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ESP control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection Procedures

DTC Inspection

1. Connect the Hi-Scan (pro) with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO ▶ Check the power source circuit.

YES ▶ Erase the DTC and recheck using scan tool.

Check The Power Source Circuit

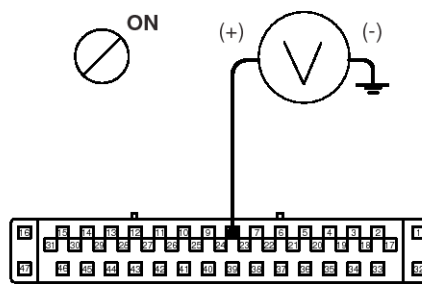
1. Disconnect the connector from the ESP control module.
2. Turn the ignition switch ON, measure the voltage between terminal 8 of the ESP control module harness side connector and body ground.

Specification: approximately B+

3. Is the voltage within specification?

YES ▶ Check the ground circuit.

NO ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ESP control module. Repair if necessary.



SBHBR8386D

BR-64

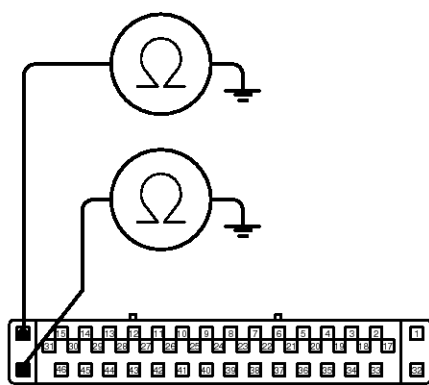
Brake System

Check The Ground Circuit

1. Disconnect the connector from the ESP control module.
2. Check for continuity between terminals 16, 47 of the ESP control module harness side connector and ground point.
3. Is there continuity?

YES ▶ Check the wheel speed sensor circuit.

NO ▶ Repair an open in the wire and ground point.



SBHBR8387D

Check The Wheel Speed Sensor Circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

YES ▶ Check the hydraulic circuit for leakage.

NO ▶ Repair or replace the wheel speed sensor.

Check The Hydraulic Circuit For Leakage

1. Refer to the hydraulic lines.
2. Inspect leakage of the hydraulic lines.
3. Is it normal?

YES ▶ The problem is still occurring, replace the ESP control module.

NO ▶ Repair the hydraulic lines for leakage.

ESP(Electronic Stability Program) System

BR-65

ABS Does Not Operate (Intermittently).

STQBR8320L

Detecting Condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ESP control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection Procedures

DTC Inspection

1. Connect the scan tool with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO ▶ Check the wheel speed sensor circuit.

YES Erase the DTC and recheck using scan tool.

Check The Wheel Speed Sensor Circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

YES ▶ Check the stop lamp switch circuit.

NO ▶ Repair or replace the wheel speed sensor.

Check The Stop Lamp Switch Circuit

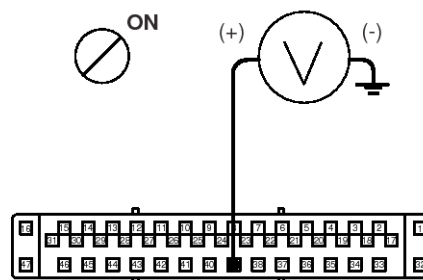
1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 39 of the ESP control module harness side connector and body ground when brake pedal is depressed.

Specification : approximately B+

3. Is the voltage within specification?

YES ▶ Check the hydraulic circuit for leakage.

NO ▶ Repair the stop lamp switch. Repair an open in the wire between the ESP control module and the stop lamp switch.



SBHBR8388D

Check The Hydraulic Circuit For Leakage

1. Refer to the hydraulic lines.
2. Inspection leakage of the hydraulic lines.
3. Is it normal?

YES ▶ The problem is still occurring, replace the ESP control module.

NO ▶ Repair the hydraulic lines for leakage.

BR-66

Brake System

Communication with Scan-Tool is not possible.
(Communication with any system is not possible)

STQBR8321L

Detecting Condition

Trouble Symptoms	Possible Cause
Possible defect in the power supply system (including ground) for the diagnosis line.	- An open in the wire - Poor ground - Faulty power source circuit

Inspection Procedures

Check The Power Supply Circuit For The Diagnosis

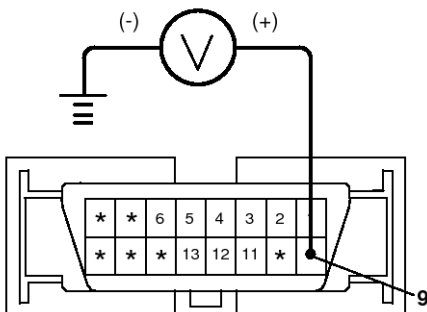
1. Measure the voltage between terminal 9 of the data link connector and body ground.

Specification : approximately B+

2. Is voltage within specification?

YES ▶ Check the ground circuit for the diagnosis.

NO ▶ Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block.

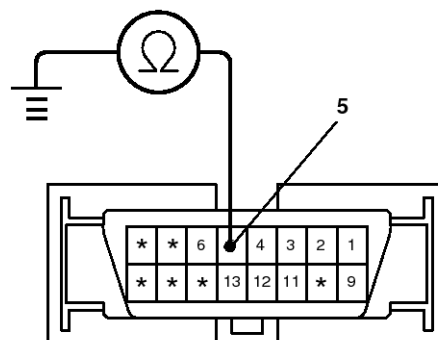


SBHBR8389D

Check The Ground Circuit For The Diagnosis

1. Check for continuity between terminal 5 of the data link connector and body ground.
2. Is there continuity?

NO ▶ Repair an open in the wire between terminal 5 of the data link connector and ground point.



SBHBR8390D

ESP(Electronic Stability Program) System

BR-67

Communication with Scan Tool is not possible.
(Communication with ABS only is not possible)

STQBR8322L

Detecting Condition

Trouble Symptoms	Possible Cause
When communication with scan tool is not possible, the cause may be probably an open in the HECU power circuit or an open in the diagnosis output circuit.	- An open in the wire - Faulty HECU - Faulty power source circuit

Inspection Procedures

Check For Continuity In The Diagnosis Line

1. Disconnect the connector from the ESP control module.
2. Check for continuity between terminals 13 of the ESP control module connector and 1 of the data link connector.
3. Is there continuity?

YES ▶ Check the power source of ESP control module.

NO ▶ Repair an open in the wire.

Check The Power Source Of ABS Control Module

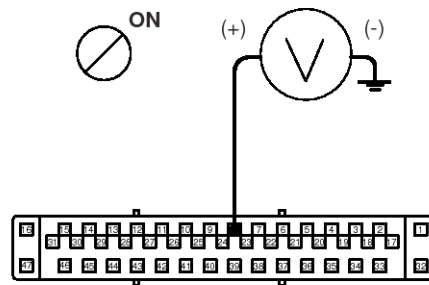
1. Disconnect the connector from the ESP control module.
2. Turn the ignition switch ON, measure the voltage between terminal 8 of the ESP control module harness side connector and body ground.

Specification : approximately B+

3. Is voltage within specification?

YES ▶ Check for poor ground.

NO ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ESP control module. Repair if necessary.



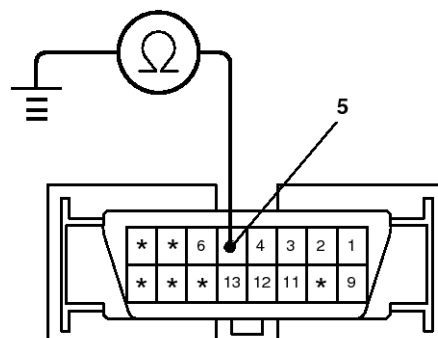
SBHBR8386D

Check For Poor Ground

1. Check for continuity between terminal 5 of the data link connector and ground point.

YES ▶ Replace the ESP control module and recheck.

NO ▶ Repair an open in the wire or poor ground



SBHBR8390D

BR-68

Brake System

When Ignition Key Is Turned ON (engine OFF), The ABS Warning Lamp Does Not Light Up.

STQBR8323L

Detecting Condition

Trouble Symptoms	Possible Cause
When current flows in the HECU the ABS warning lamp turns from ON to OFF as the initial check. Therefore if the lamp does not light up, the cause may be an open in the lamp power supply circuit, a blown bulb, an open in the both circuits between the ABS warning lamp and the H-ECU, and the faulty HECU.	- Faulty ABS warning lamp bulb - Blown fuse is related to ABS in the engine compartment junction block - Faulty ABS warning lamp module - Faulty HECU

Inspection Procedures

Problem Verification

1. Disconnect the connector the ABS HECU and turn the ignition switch ON.
2. Does the ABS warning lamp light up?

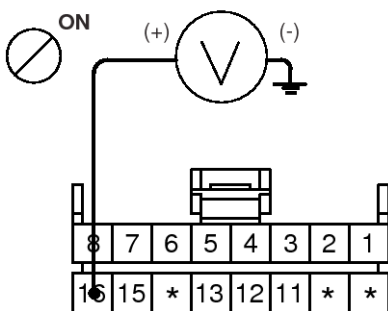
NO ▶ Check the power source for the ABS warning lamp.

YES ▶ Inspect again after replacing the ABS HECU

Check The Power Source For The ABS Warning Lamp

1. Disconnect the instrument cluster connector and turn the ignition switch ON.
2. Measure the voltage between terminal 16 of the cluster harness side connector and body ground.

Specification : approximately B+



SBHBR8393D

3. Is voltage within specification?

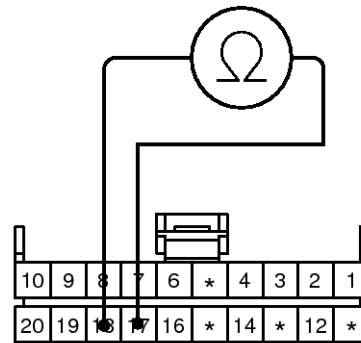
NO ▶ Check for blown fuse.

YES ▶ Check the CAN circuit resistance for ABS warning lamp.

Check The Can Circuit Resistance For ABS Warning Lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M11-B) 17 and 18 of the cluster harness side connector.

Specification : 60Ω



SBHBR8394D

3. Is resistance within specification?

YES ▶ Check the CAN circuit wiring for ABS warning lamp.

NO ▶ Repair ABS warning lamp bulb or instrument cluster assembly.

ESP(Electronic Stability Program) System

BR-69

Check The Can Circuit Wiring For ABS Warning Lamp

1. Disconnect the instrument cluster connector (M11-B) and ESP HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M11-B) 18 of the cluster harness side connector and terminal 12 of ESP HECU harness side.

Check for continuity between terminal (M11-B) 17 of the cluster harness side connector and terminal 13 of ESP HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES ► Repair open of wiring between terminal 12, 13 of ESP HECU harness connector and ABS warning lamp module.

NO ► Repair short of wiring between terminal 12, 13 of ESP HECU harness connector and ABS warning lamp module.

BR-70

Brake System

Even After The Engine Is Started, The ABS Warning Lamp Remains ON.

STQBR8324L

Detecting Condition

Trouble Symptoms	Possible Cause
If the HECU detects trouble, it lights the ABS warning lamp while at the same time prohibiting ABS control. At this time, the HECU records a DTC in memory. Even though the normal code is output, the ABS warning lamp remains ON, then the cause may be probably an open or short in the ABS warning lamp circuit.	- An open in the wire - Faulty instrument cluster assembly - Faulty ABS warning lamp module - Faulty HECU

Inspection Procedures

Check DTC Output

1. Connect the scan tool to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using scan tool.
3. Is DTC output?

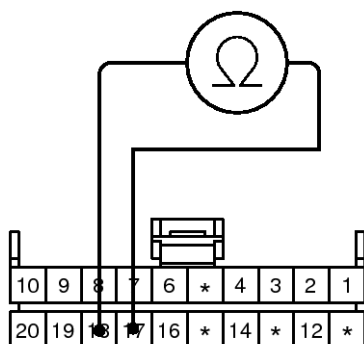
NO ► Check the CAN circuit resistance for ABS warning lamp.

YES ► Perform the DTC troubleshooting procedure (Refer to DTC troubleshooting).

Check The Can Circuit Resistance For ABS Warning Lamp

1. Disconnect the instrument cluster connector (M11-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M11-B) 17 and 18 of the cluster harness side connector.

Specification : 60Ω



SBHBR8394D

3. Is resistance within specification?

YES ► Check the CAN circuit wiring for ABS warning lamp.

NO ► Repair ABS warning lamp bulb or instrument cluster assembly.

Check The Can Circuit Wiring For ABS Warning Lamp

1. Disconnect the instrument cluster connector (M11-B) and ESP HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M11-B) 18 of the cluster harness side connector and terminal 12 of ESP HECU harness side.
Check for continuity between terminal (M11-B) 17 of the cluster harness side connector and terminal 13 of ESP HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES ► Repair open of wiring between terminal 12, 13 of ESP HECU harness connector and ABS warning lamp module.

NO ► Repair short of wiring between terminal 12, 13 of ESP HECU harness connector and ABS warning lamp module.
If no trouble in wiring, inspect again after replacing the ABS HECU.

ESP(Electronic Stability Program) System

BR-71

Bleeding of Brake System

This procedure should be followed to ensure adequate bleeding of air and filling of the ABS unit, brake lines and master cylinder with brake fluid.

1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

⚠CAUTION

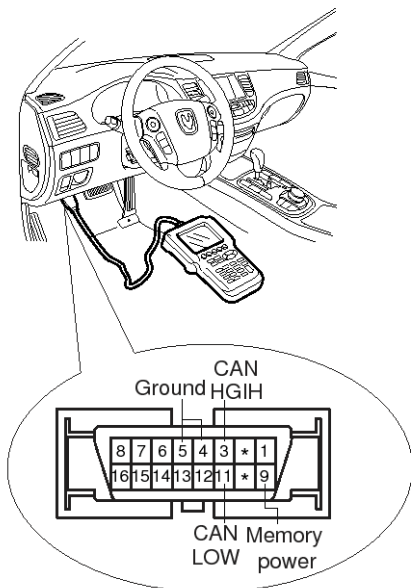
If there is any brake fluid on any painted surface, wash it off immediately.

📖NOTICE

When pressure bleeding, do not depress the brake pedal.

Recommended fluid..... DOT3 or DOT4

2. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.
3. Connect the scan tool to the data link connector located underneath the dash panel.



SBHBR9312L

4. Select and operate according to the instructions on the scan tool screen.

⚠CAUTION

You must obey the maximum operating time of the ABS motor with the scan tool to prevent the motor pump from burning.

- 1) Select vehicle name.
- 2) Select Anti-Lock Brake system.
- 3) Select air bleeding mode.

- 4) Press "YES" to operate motor pump and solenoid valve.

< PRE BLEEDING >

1. Perform the bleeding of conventional parts certainly.
2. Press [ENTER] key to activate pump motor and all NC valves.

SUNBR6522L

- 5) Wait 120 sec. before operating the air bleeding.
(If not, you may damage the motor.)

NOW, ALL NC VALVES AND PUMP MOTOR ARE ACTIVATING. DURING THIS TIME, IT SHOULD BE REPEATED THAT DEPRESSING THE BRAKE PEDAL UNTIL IT REACHES TO THE BOTTOM OF FLOOR WITHOUT REACTION AND RELEASING THE BRAKE PEDAL UNTIL THE KICK BACK SITUATION IS OVER.

PLEASE WAIT 120 SECONDS.

SUNBR6523L

- 6) Perform the air bleeding.

< FINAL BLEEDING >

1. Perform the bleeding of conventional parts certainly.
2. If the brake pedal stroke is not so good after above procedure, perform the all procedure more some times and recheck the brake pedal stroke.
3. Press [ENTER] key to return the first bleeding mode.

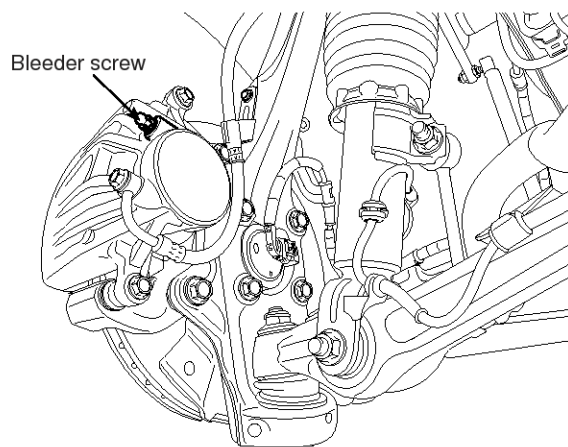
SUNBR6621L

BR-72

Brake System

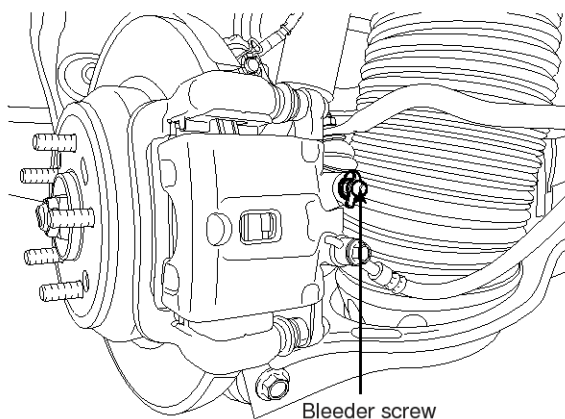
5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.

Front



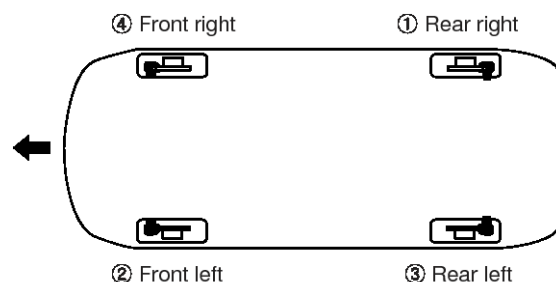
SBHBR9313L

Rear



SBHBR9314L

6. Repeat step 5 until there are no more bubbles in the fluid for each wheel.



KJKE003B

7. Tighten the bleeder screw.

Bleed screw tightening torque:

6.9 ~ 12.7 Nm (0.7 ~ 1.3 kgf.m, 5.1 ~ 9.4 lb-ft)

ESP(Electronic Stability Program) System

BR-73

Diagnostic Trouble Codes (DTC)

DTC	DTC Name	Warning Lamp			Remark
		EBD	ABS	ESP	
C1101	Battery Voltage High	●	●	●	
C1102	Battery Voltage Low	○/●	●	●	
C1200	Wheel Speed Sensor Front-LH Open/Short	○/●	●	●	
C1201	Wheel Speed Sensor Front-LH Range / Performance / Intermittent	○/●	●	●	
C1202	Wheel Speed Sensor Front-LH Invalid/no Signal	○/●	●	●	
C1203	Wheel Speed Sensor Front-RH Open/Short	○/●	●	●	
C1204	Wheel Speed Sensor Front-RH Range / Performance / Intermittent	○/●	●	●	
C1205	Wheel Speed Sensor Front-RH Invalid/no Signal	○/●	●	●	
C1206	Wheel Speed Sensor Rear-LH Open/Short	○/●	●	●	
C1207	Wheel Speed Sensor Rear-LH Range / Performance / Intermittent	○/●	●	●	
C1208	Wheel Speed Sensor Rear-LH Invalid/no Signal	○/●	●	●	
C1209	Wheel Speed Sensor Rear-RH Open/Short	○/●	●	●	
C1210	Wheel Speed Sensor Rear-RH Range / Performance / Intermittent	○/●	●	●	
C1211	Wheel Speed Sensor Rear-RH Invalid/no Signal	○/●	●	●	
C1235	Primary Pressure Sensor-Electrical	○	○	●	
C1237	Primary Pressure Sensor-Signal	○	○	●	
C1260	Steering Angle Sensor Circuit-Signal	○	○	●	
C1261	Steering Angle Sensor Not Calibrated	○	○	●	
C1274	Longitudinal G Sensor-Electrical	○	○	○	
C1275	Longitudinal G Sensor Range/Performance error	○	○	○	
C1282	Yaw Rate & Lateral G Sensor-Electrical	○	○	●	
C1283	Yaw Rate & Lateral G Sensor-Signal	○	○	●	
C1503	TCS/ESP Switch error	○	○	○	
C1513	Brake switch error	○	○	○	
C1604	ECU Hardware Error	●	●	●	
C1605	CAN Hardware error	○	○	●	
C1611	CAN Time-out ECM	○	○	●	
C1612	CAN Time-out TCM	○	○	●	
C1613	CAN signal error ECM (Check ECM)	○	○	●	
C1616	CAN Communication Bus Off	○	○	●	

BR-74

Brake System

DTC	DTC Name	Warning Lamp			Remark
		EBD	ABS	ESP	
C1623	CAN Time-out Steering Angle Sensor	○	○	●	
C1626	Implausible Control	○	○	●	
C1702	Variant Coding Error	○	●	●	
C2112	Valve Relay Error	●	●	●	
C2227	Excessive Temperature of Brake Disc	○	○	●	
C2308	Front-LH Valve error (Inlet Valve)	●	●	●	
C2312	Front-LH Valve error (Outlet Valve)	●	●	●	
C2316	Front-RH Valve error (Inlet Valve)	●	●	●	
C2320	Front-RH Valve error (Outlet Valve)	●	●	●	
C2324	Rear-LH Valve error (Inlet Valve)	●	●	●	
C2328	Rear-LH Valve error (Outlet Valve)	●	●	●	
C2332	Rear-RH Valve error (Inlet Valve)	●	●	●	
C2336	Rear-RH Valve error (Outlet Valve)	●	●	●	
C2366	TC Valve Primary (USV1) Error	●	●	●	
C2370	TC Valve Secondary (USV2) Error	●	●	●	
C2372	Electronic Shuttle Valve Primary (HSV1) Error	●	●	●	
C2374	Electronic Shuttle Valve Secondary (HSV2) Error	●	●	●	
C2380	ABS/TCS/ESP valve error	●	●	●	
C2402	Motor Failure	○	●	●	

ESP(Electronic Stability Program) System

BR-75

C1101 Battery Voltage High

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication.

The ESP ECU(HECU, Hydraulic and Electronic Control Unit) checks the battery voltage and alternator output voltage to determine, as a safety issue, whether this system can operate normally or not. The normal battery voltage range is essential for controlling this system as intended.

DTC Description

The HECU monitors the voltage of battery and if it stays more than 17 Volts, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitoring the voltage of battery	• Poor connection in power supply circuit • Faulty Alternator • Faulty HECU
Threshold value	• When Battery voltage is more than 17V	
Fail-Safe	• ABS/EBD/TCS/ESP functions are inhibited. • ABS/EBD/ESP warning lamps are activated.	

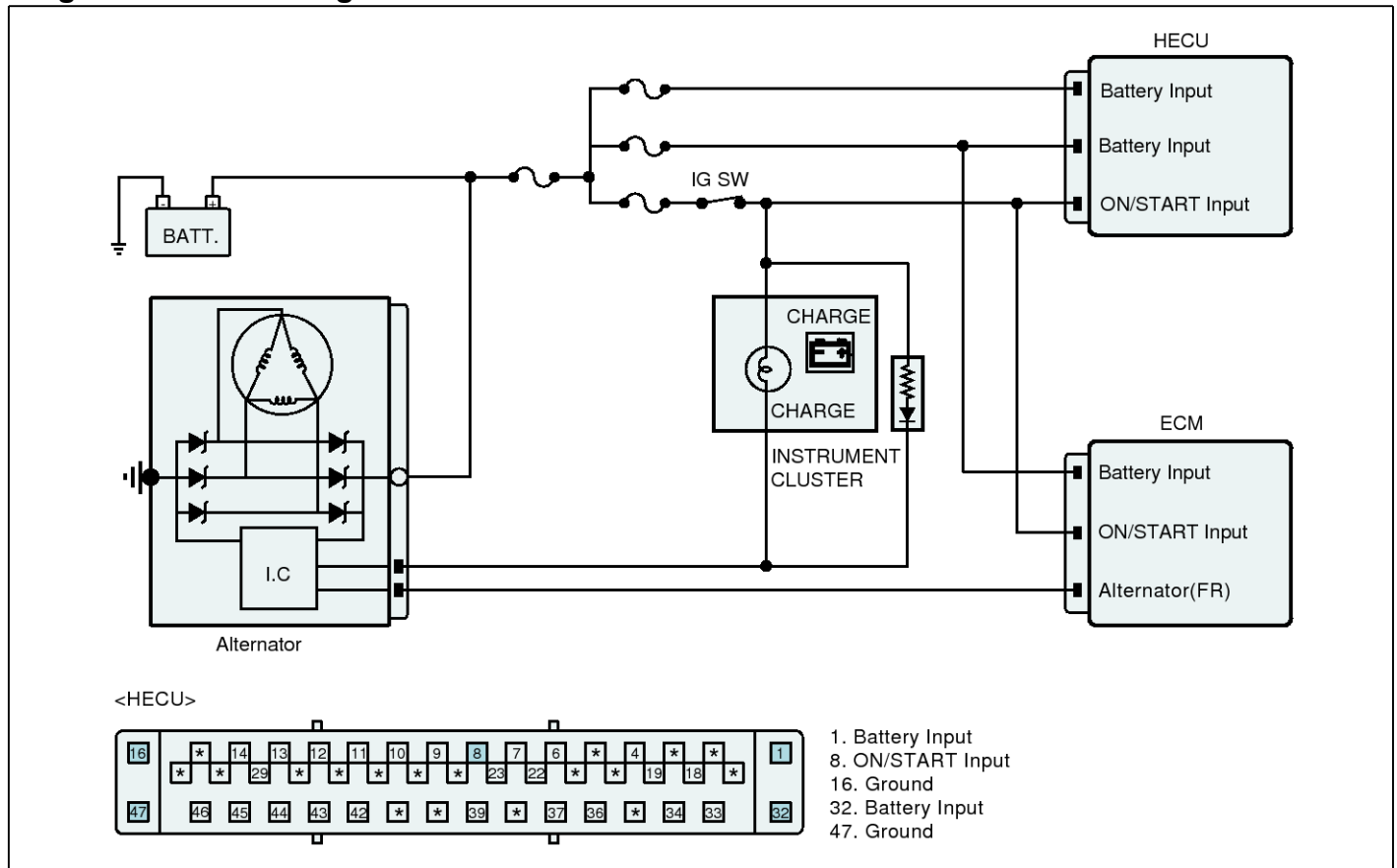
Specifications

Normal Voltage Range	IGN "ON" or Engine "ON"
	10V ~ 16V

BR-76

Brake System

Diagnostic Circuit Diagram



SBHBR9501L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG ON or Engine ON

3. Monitor the "BATTERY VOLTAGE" parameter on the scantool.

Specification : Below 17.0V

Sensor Name	Value	Unit
☒ Battery Positive Voltage	14.3	V

Fig.1

Fig.1) Normal data at the idle state

SBHBR9600L

4. Is the battery voltage normal?

YES ► Fault is intermittent caused by poor connection in power harness (IGN+) and/or HECU's connector or was repaired and HECU memory was not cleared.

Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Terminal and Connector Inspection" procedure.

ESP(Electronic Stability Program) System

BR-77

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Alternator Output Voltage Inspection" procedure.

Alternator Output Voltage Inspection

1. Ignition "ON" & Engine "ON".
2. Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : $14.4 \pm 0.6V$ (20°C)

3. Is the measured value within specifications?

YES ▶ Go to "Power Circuit Inspection" procedure.

NO ▶ Check that the tension of drive belt, ENG RPM, fuse, terminal of battery, all terminals of alternator are in good condition and Check for damaged harness and poor connection between alternator and battery. If OK repair or replace alternator and then go to "Verification of vehicle Repair" procedure.

Power Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between the battery terminal(+) and power terminal of the HECU harness connector.

Specification : Approx. below 0.2V

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU and then go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ Repair open or short in ground circuit between HECU and chassis ground and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-78

Brake System

C1102 Battery Voltage Low

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. The ESP ECU (HECU, Hydraulic and Electronic Control Unit) checks the battery voltage and alternator output voltage to determine, as a safety issue, whether this system can operate normally or not. The normal battery voltage range is essential for controlling this system as intended.

DTC Description

The HECU monitors the voltage of battery and if it stays below certain value, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitoring the voltage of battery	• Poor connection in power supply circuit • Faulty HECU
Case1 (Low voltage)	Threshold value	• When Battery voltage is below 10V	
	Fail-Safe	• The ABS/TCS/ESP functions are inhibited. • The ABS/ESP warning lamps are activated.	
Case2 (Under voltage)	Threshold value	• When Battery voltage is below 8.45V	
	Fail-Safe	• The ABS/EBD/TCS/ESP functions are inhibited. • The ABS/EBD/ESP warning lamps are activated.	

Specifications

Normal Voltage Range	IGN "ON" or Engine "ON"
	10V ~ 16V

BR-80

Brake System

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between the battery terminal(+) and power terminal of the HECU harness connector.

Specification : Approx. below 0.2V

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU and then go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ Repair open or short in ground circuit between HECU and chassis ground and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-81

C1200 Wheel Speed Sensor Front-LH Open/Short

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's circuit and If it's signal current is continuously out of the specified range, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitoring the signal current	- Poor connection - Open or short of Wheel speed sensor circuit - Faulty Wheel speed sensor
Threshold value	When the measured sensor signal current is continuously out of the specified range ($4.5 \text{ mA} \pm 10\% \sim 20 \text{ mA} \pm 10\%$)	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	46	0.4~1.5mm

ESP(Electronic Stability Program) System

BR-83

Power Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU and wheel speed sensor and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and signal terminal of HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and chassis ground.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short in the signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation. If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1201 Wheel Speed Sensor Front-LH Range / Performance / Intermittent

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's signal and If its signal is abnormally changed or the signal equivalent to 411 km/h is detected, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case1 (WSS fault)	DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
	Threshold value	After IG ON, when the change of a vehicle speed is over 35 km/h(21.7 mph), this monitoring is started. And the change of a wheel deceleration or acceleration is over 1.6G. Or the vehicle speed is detected as a 411 km/h(255 mph) for a certain time.	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	
Case2 (Rotor fault)	DTC Strategy	Signal Monitoring	
	Threshold value	when the signal error of a wheel speed is continuously detected 15 times at a special rotor's position	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

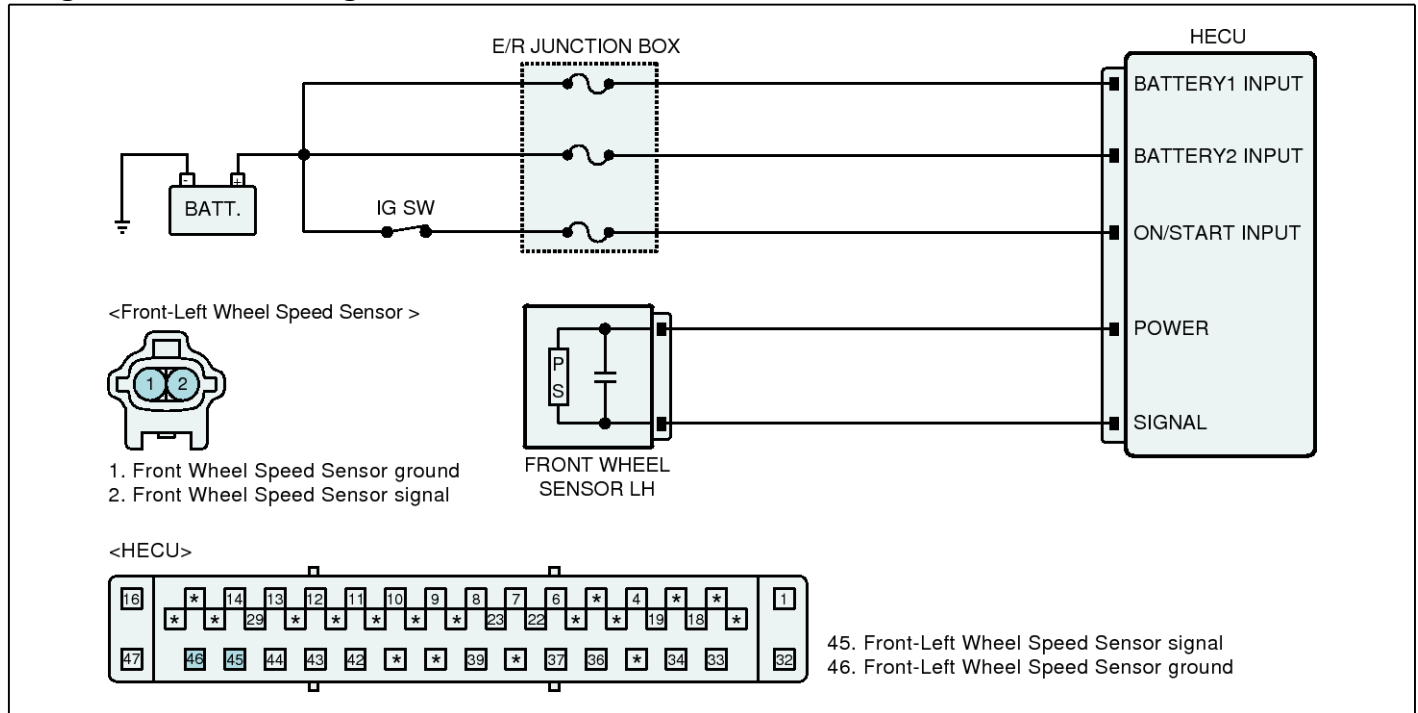
ESP(Electronic Stability Program) System

BR-85

Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	46	0.4~1.5mm

Diagnostic Circuit Diagram



SBHBR9502L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Front-Left)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES ► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► 1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) When there is no fault about installation or rotor teeth, Go to "Component Inspection" procedure.

BR-86

Brake System

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ► Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ► Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-87

C1202 Wheel Speed Sensor Front-LH Invalid/no Signal

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor signal continuously and if the signal of a wheel speed sensor is omitted or too low, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
Threshold valve	- Vehicle speed ≥ 10 kph(6.2 mph) - when the maximum wheel speed is continuously over 10 km/h(6.2mph) and the other wheel speed is below 2 km/h(1.2 mph) for more than 180 seconds - Vehicle speed ≥ 15 kph (9.3 mph) 1. when the maximum wheel speed is continuously over 15km/h(9.3 mph) and the minimum wheel speed is below $(0.4 \times \text{the maximum wheel speed})$ for more than 120 seconds 2. when the maximum wheel speed is continuously over 40km/h(24.8 mph) and the minimum wheel speed is below $(0.6 \times \text{the maximum wheel speed})$ for more than 120 seconds	
	when the brake pressure goes down or keeps up for more than 28 seconds	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

ESP(Electronic Stability Program) System

BR-89

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-90

Brake System

C1203 Wheel Speed Sensor Front-RH Open/Short

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's circuit and If it's signal current is continuously out of the specified range, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitoring the signal current	- Poor connection - Open or short of Wheel speed sensor circuit - Faulty Wheel speed sensor
Threshold value	When the measured sensor signal current is continuously out of the specified range ($4.5 \text{ mA} \pm 10\% \sim 20 \text{ mA} \pm 10\%$)	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

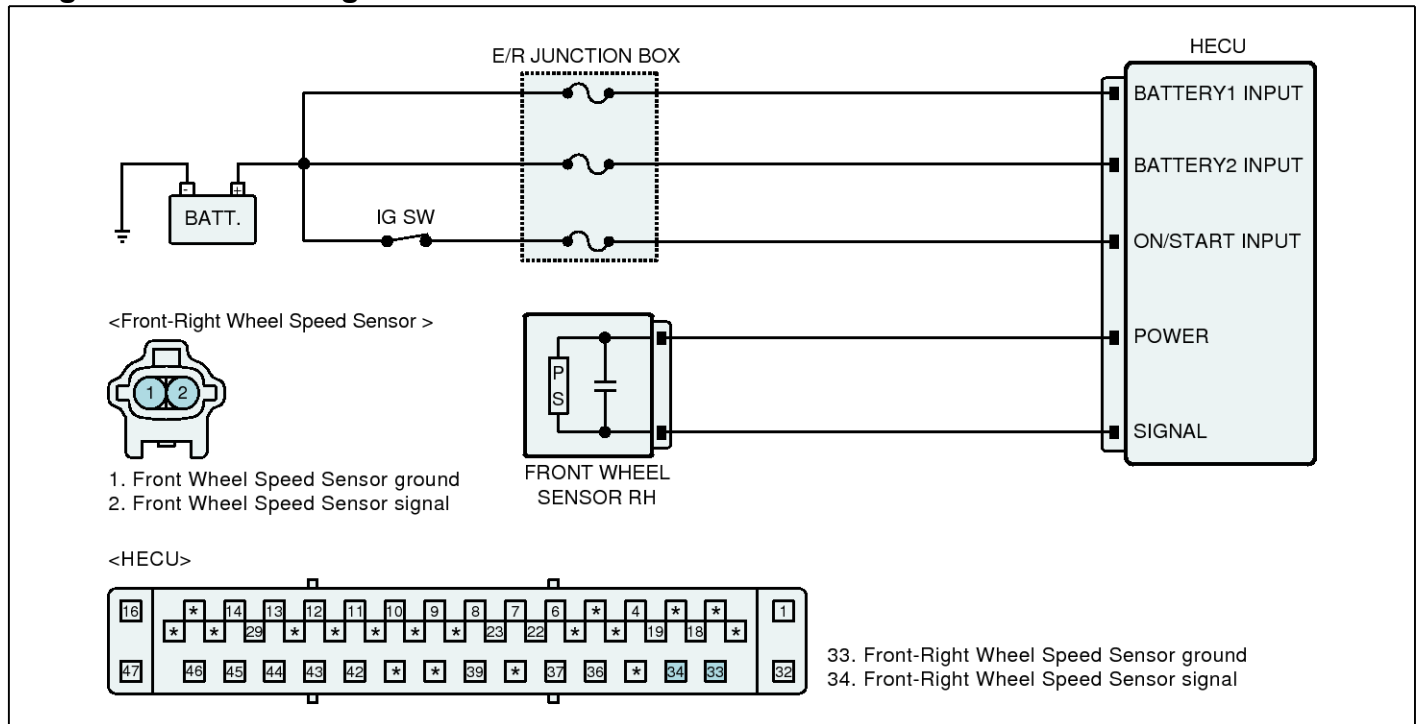
Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	46	0.4~1.5mm

ESP(Electronic Stability Program) System

BR-91

Diagnostic Circuit Diagram



SBHBR9503L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Front-Right)" parameter on the Scantool

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES ► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure

NO ► Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" procedure.

BR-92

Brake System

Power Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU and wheel speed sensor and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and signal terminal of HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and chassis ground.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short in the signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation. If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-93

C1204 Wheel Speed Sensor Front-RH Range / Performance / Intermittent

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's signal and If its signal is abnormally changed or the signal equivalent to 411 km/h is detected, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case1 (WSS fault)	DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
	Threshold value	After IG ON, when the change of a vehicle speed is over 35 km/h(21.7 mph), this monitoring is started. And the change of a wheel deceleration or acceleration is over 1.6G. Or the vehicle speed is detected as a 411 km/h(255 mph) for a certain time.	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	
Case2 (Rotor fault)	DTC Strategy	Signal Monitoring	
	Threshold value	when the signal error of a wheel speed is continuously detected 15 times at a special rotor's position	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

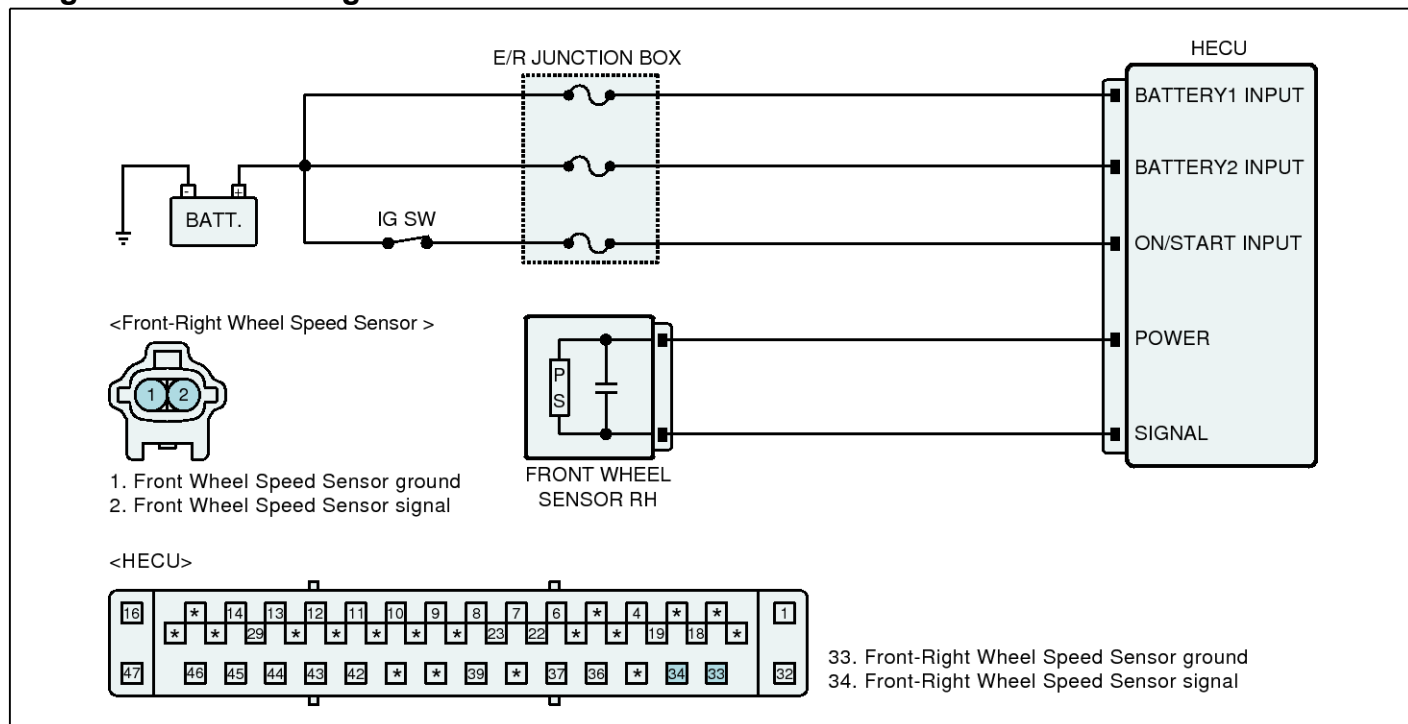
BR-94

Brake System

Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	46	0.4~1.5mm

Diagnostic Circuit Diagram



SBHBR9503L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Front-Right)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES

► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

► 1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) When there is no fault about installation or rotor teeth, Go to "Component Inspection" procedure.

ESP(Electronic Stability Program) System

BR-95

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1205 Wheel Speed Sensor Front-RH Invalid/no Signal

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor signal continuously and if the signal of a wheel speed sensor is omitted or too low, this DTC is set.

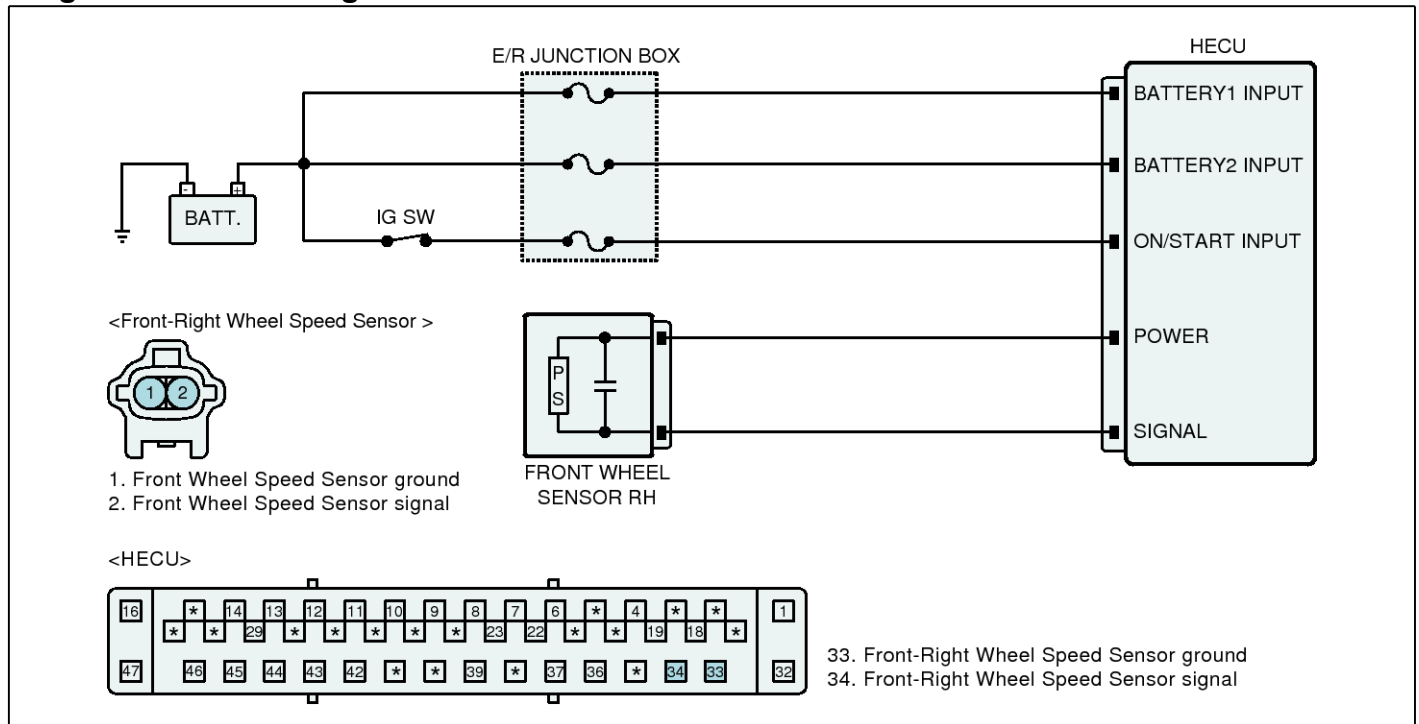
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
Threshold valve	- Vehicle speed ≥ 10 kph(6.2 mph) - when the maximum wheel speed is continuously over 10 km/h(6.2mph) and the other wheel speed is below 2 km/h(1.2 mph) for more than 180 seconds - Vehicle speed ≥ 15 kph (9.3 mph) 1. when the maximum wheel speed is continuously over 15km/h(9.3 mph) and the minimum wheel speed is below $(0.4 \times \text{the maximum wheel speed})$ for more than 120 seconds 2. when the maximum wheel speed is continuously over 40km/h(24.8 mph) and the minimum wheel speed is below $(0.6 \times \text{the maximum wheel speed})$ for more than 120 seconds	
	when the brake pressure goes down or keeps up for more than 28 seconds	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

ESP(Electronic Stability Program) System

BR-97

Diagnostic Circuit Diagram



SBHBR9503L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Front-Right)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES

► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

► 1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) When there is no fault about installation or rotor teeth, Go to "Component Inspection" procedure.

BR-98

Brake System

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ► Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ► Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-99

C1206 Wheel Speed Sensor Rear-LH Open/Short

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's circuit and If it's signal current is continuously out of the specified range, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitoring the signal current	- Poor connection - Open or short of Wheel speed sensor circuit - Faulty Wheel speed sensor
Threshold value	When the measured sensor signal current is continuously out of the specified range ($4.5 \text{ mA} \pm 10\% \sim 20 \text{ mA} \pm 10\%$)	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

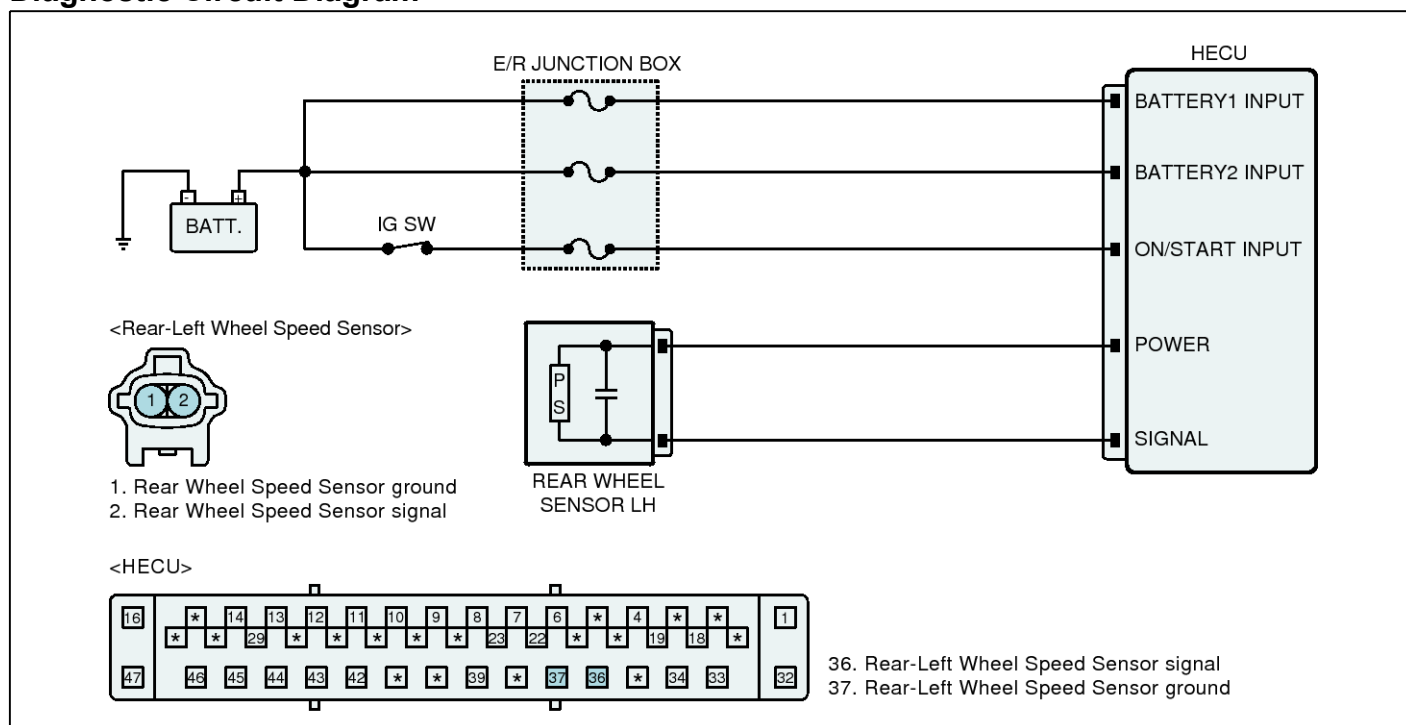
Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	47 EA	0.4~1.5mm

BR-100

Brake System

Diagnostic Circuit Diagram



SBHBR9504L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Rear-Left)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES ► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure

NO ► Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" procedure.

ESP(Electronic Stability Program) System

BR-101

Power Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU and wheel speed sensor and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and signal terminal of HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and chassis ground.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short in the signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation. If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-102

Brake System

C1207 Wheel Speed Sensor Rear-LH Range / Performance / Intermittent

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's signal and If its signal is abnormally changed or the signal equivalent to 411 km/h is detected, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case1 (WSS fault)	DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
	Threshold value	After IG ON, when the change of a vehicle speed is over 35 km/h(21.7 mph), this monitoring is started. And the change of a wheel deceleration or acceleration is over 1.6G. Or the vehicle speed is detected as a 411 km/h(255 mph) for a certain time.	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	
Case2 (Rotor fault)	DTC Strategy	Signal Monitoring	
	Threshold value	when the signal error of a wheel speed is continuously detected 15 times at a special rotor's position	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

BR-104

Brake System

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-105

C1208 Wheel Speed Sensor Rear-LH Invalid/no Signal

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor signal continuously and if the signal of a wheel speed sensor is omitted or too low, this DTC is set.

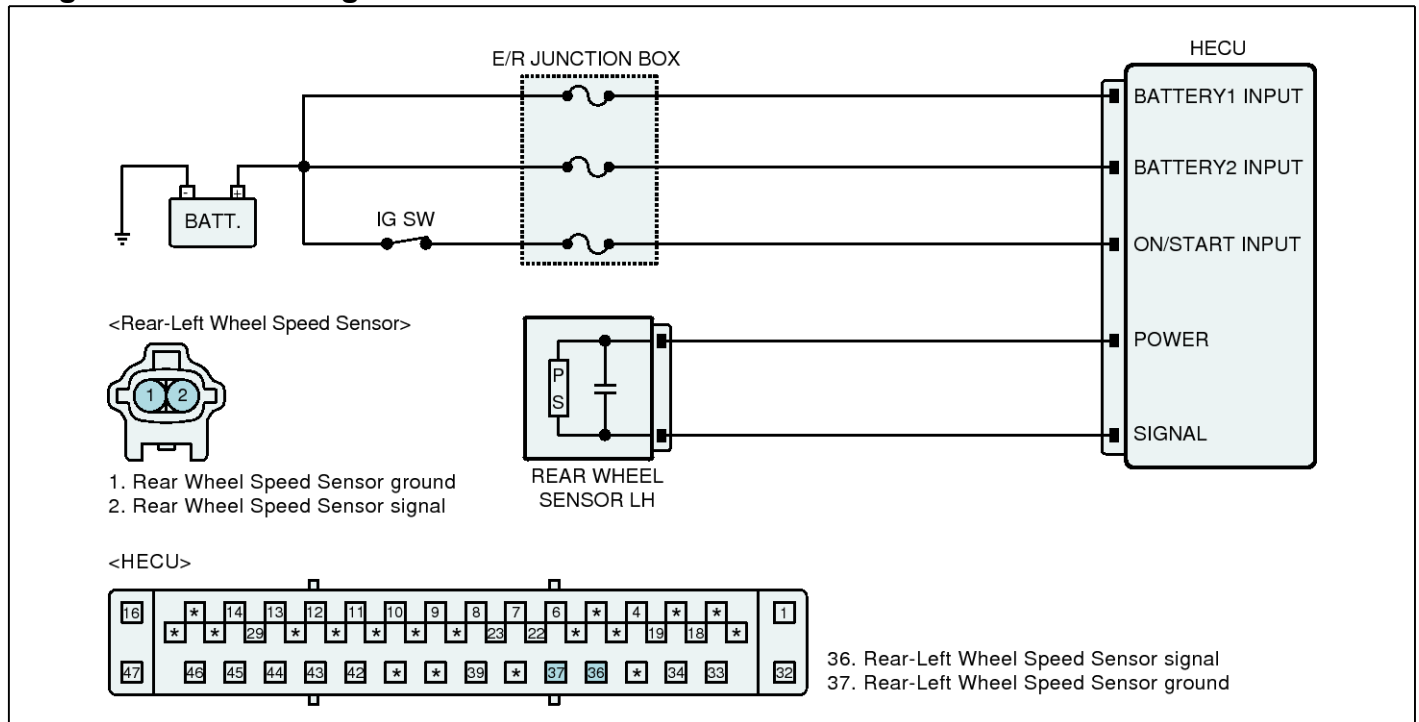
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
Threshold valve	- Vehicle speed ≥ 10 kph(6.2 mph) - when the maximum wheel speed is continuously over 10 km/h(6.2mph) and the other wheel speed is below 2 km/h(1.2 mph) for more than 180 seconds - Vehicle speed ≥ 15 kph (9.3 mph) 1. when the maximum wheel speed is continuously over 15km/h(9.3 mph) and the minimum wheel speed is below $(0.4 \times \text{the maximum wheel speed})$ for more than 120 seconds 2. when the maximum wheel speed is continuously over 40km/h(24.8 mph) and the minimum wheel speed is below $(0.6 \times \text{the maximum wheel speed})$ for more than 120 seconds	
	when the brake pressure goes down or keeps up for more than 28 seconds	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

BR-106

Brake System

Diagnostic Circuit Diagram



SBHBR9504L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Rear-Left)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES

► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure

NO

- 1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
- 2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure
- 3) When there is no fault about installation or rotor teeth, Go to "Component Inspection" procedure.

ESP(Electronic Stability Program) System

BR-107

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-108

Brake System

C1209 Wheel Speed Sensor Rear-RH Open/Short

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's circuit and If it's signal current is continuously out of the specified range, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitoring the signal current	- Poor connection - Open or short of Wheel speed sensor circuit - Faulty Wheel speed sensor
Threshold value	When the measured sensor signal current is continuously out of the specified range ($4.5 \text{ mA} \pm 10\% \sim 20 \text{ mA} \pm 10\%$)	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

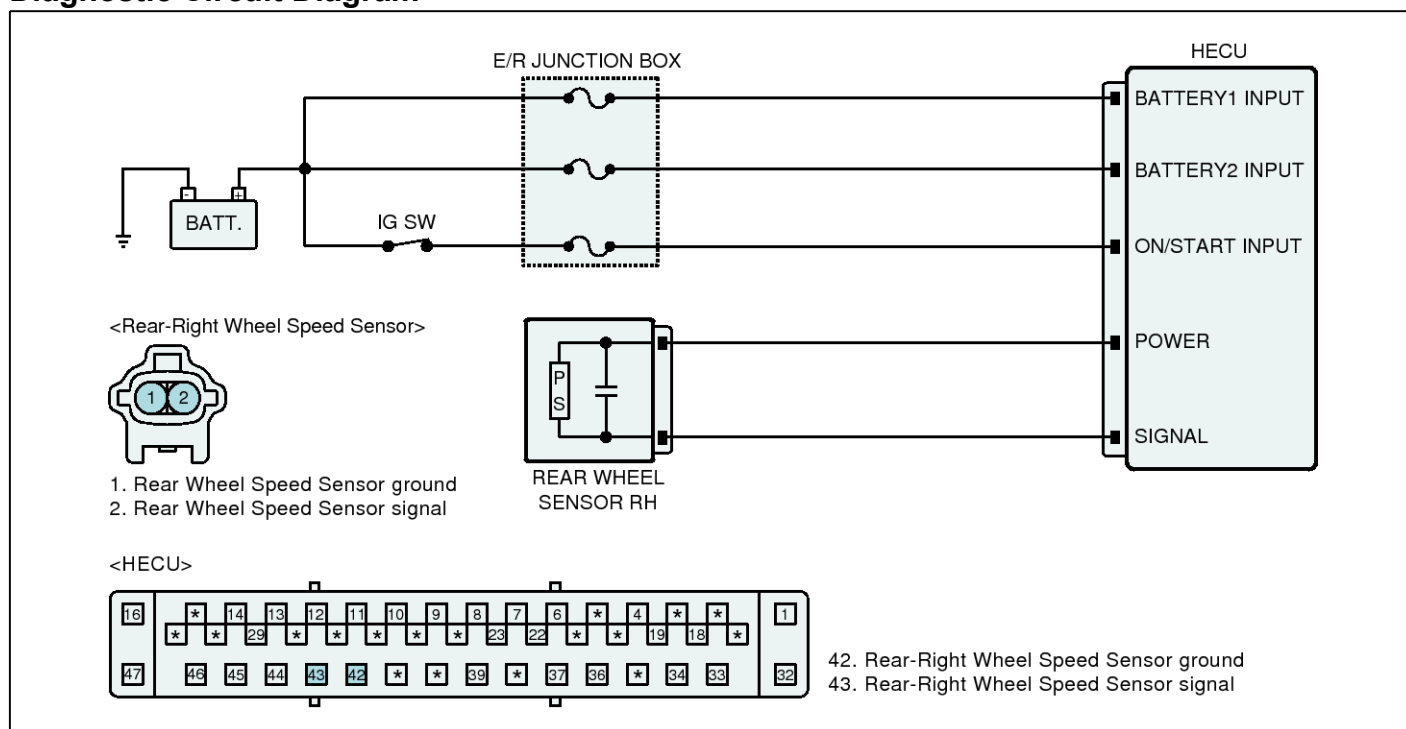
Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	47 EA	0.4~1.5mm

ESP(Electronic Stability Program) System

BR-109

Diagnostic Circuit Diagram



SBHBR9505L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Rear-Right)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES ► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure

NO ► Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" procedure.

BR-110

Brake System

Power Circuit Inspection

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU and wheel speed sensor and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and signal terminal of HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect wheel speed sensor connector and HECU connector.
3. Measure resistance between signal terminal of wheel speed sensor harness connector and chassis ground.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short in the signal circuit between wheel speed sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation. If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-111

C1210 Wheel Speed Sensor Rear-RH Range / Performance / Intermittent

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor's signal and If its signal is abnormally changed or the signal equivalent to 411 km/h is detected, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case1 (WSS fault)	DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
	Threshold value	After IG ON, when the change of a vehicle speed is over 35 km/h(21.7 mph), this monitoring is started. And the change of a wheel deceleration or acceleration is over 1.6G. Or the vehicle speed is detected as a 411 km/h(255 mph) for a certain time.	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	
Case2 (Rotor fault)	DTC Strategy	Signal Monitoring	
	Threshold value	when the signal error of a wheel speed is continuously detected 15 times at a special rotor's position	
	Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

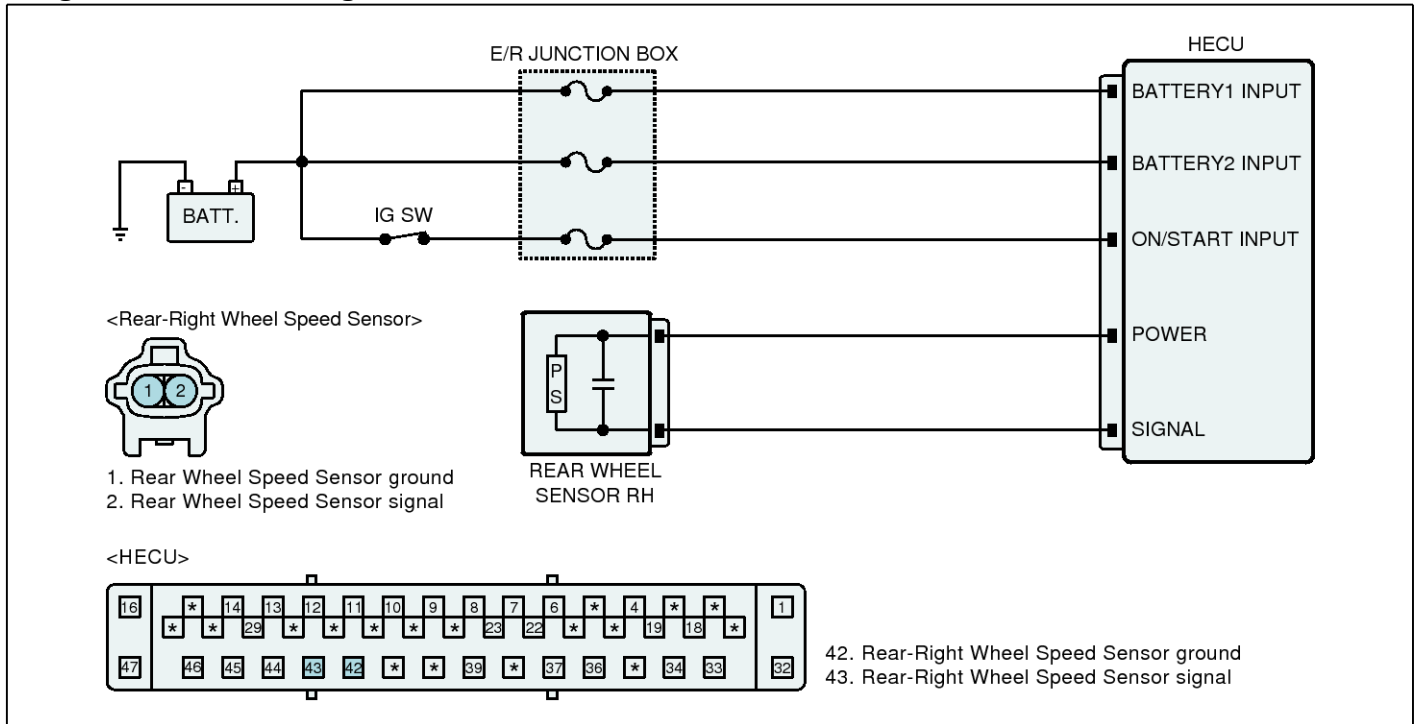
BR-112

Brake System

Specifications

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	14 mA	7 mA	47 EA	0.4~1.5mm

Diagnostic Circuit Diagram



SBHBR9505L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Rear-Right)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES ► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure .

NO ► 1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) When there is no fault about installation or rotor teeth, Go to "Component Inspection" procedure.

ESP(Electronic Stability Program) System

BR-113

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-114

Brake System

C1211 Wheel Speed Sensor Rear-RH Invalid/no Signal

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the wheel speed sensor(WSS) is the essential component of the brake system. The ESP ECU(HECU, Hydraulic and Electronic Control Unit) uses the wheel speed sensor's signals to calculate a vehicle speed and also to determine whether a wheel lock occurs or not.

DTC Description

The HECU monitors the wheel speed sensor signal continuously and if the signal of a wheel speed sensor is omitted or too low, this DTC

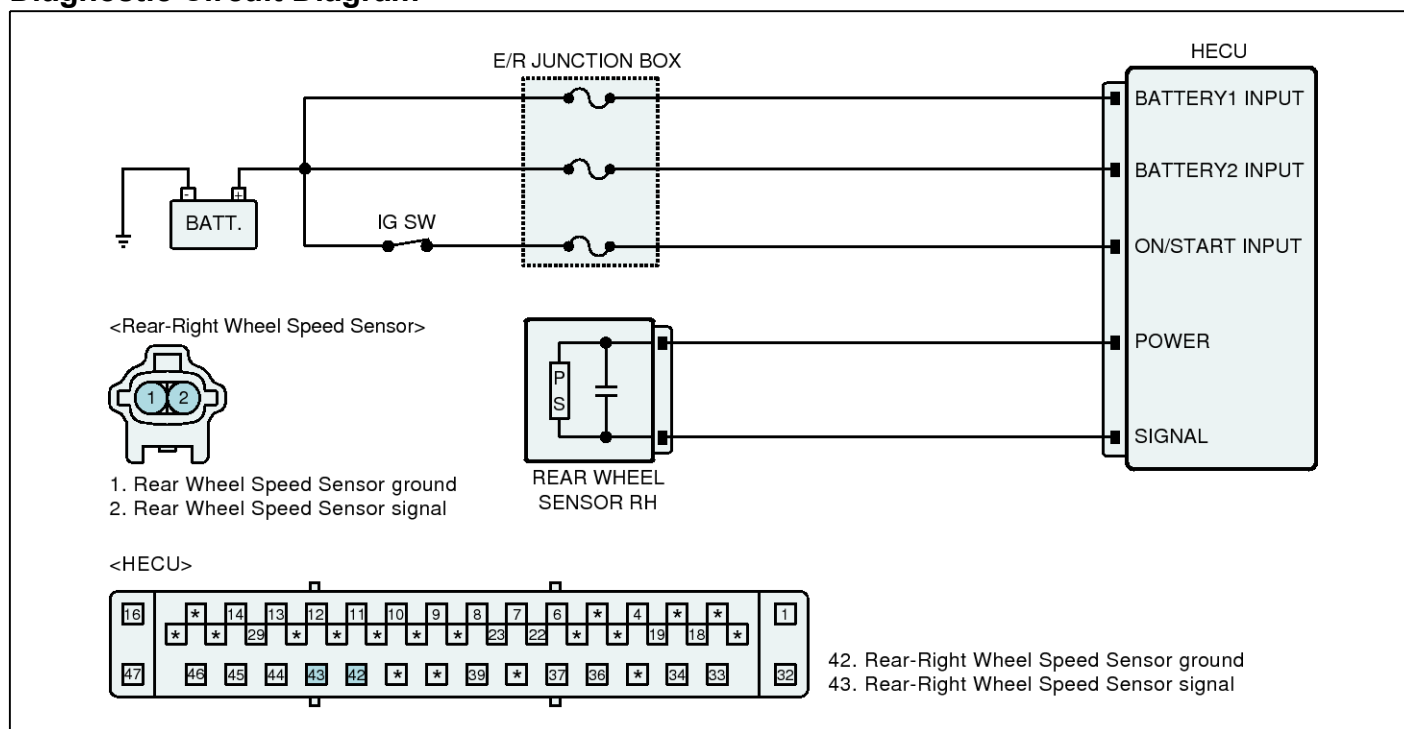
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Monitoring	- Poor connection - Improper installation of wheel speed sensor - Abnormal Rotor and wheel bearing - Faulty Wheel speed sensor
Threshold valve	- Vehicle speed ≥ 10 kph(6.2 mph) - when the maximum wheel speed is continuously over 10 km/h(6.2mph) and the other wheel speed is below 2 km/h(1.2 mph) for more than 180 seconds - Vehicle speed ≥ 15 kph (9.3 mph) 1. when the maximum wheel speed is continuously over 15km/h(9.3 mph) and the minimum wheel speed is below $(0.4 \times \text{the maximum wheel speed})$ for more than 120 seconds 2. when the maximum wheel speed is continuously over 40km/h(24.8 mph) and the minimum wheel speed is below $(0.6 \times \text{the maximum wheel speed})$ for more than 120 seconds	
	when the brake pressure goes down or keeps up for more than 28 seconds	
Fail-Safe	- Only one wheel failure : The ABS/TCS/ESP functions are inhibited. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. - More than two wheels failure : The ABS/EBD/TCS/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

ESP(Electronic Stability Program) System

BR-115

Diagnostic Circuit Diagram



SBHBR9505L

Monitor Scantool Data

1. Start engine.
2. Connect scantool to Data Link Connector(DLC).
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(Rear-Right)" parameter on the Scantool.

Specification : Compare with other service data related to wheel speed sensor.

If it is the same as other service data, it is in normal condition.

5. Is the service data displayed within specifications?

YES

► Fault is intermittent caused by poor connection in wheel speed sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

► 1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) When there is no fault about installation or rotor teeth, Go to "Component Inspection" procedure.

BR-116

Brake System

Component Inspection

1. IG "OFF"
2. Start engine.
3. Drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. When it is compared with other service data related to wheel speed sensor, is it different from other service data?

YES ► Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

NO ► Fault is intermittent caused by poor connection in wheel speed sensor harness.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-117

C1235 Primary Pressure Sensor-Electrical

General Description

The pressure sensor is installed in the HECU(Hydraulic and Electronic Control Unit) in the purpose of sensing the driver's braking intention. This sensor has two circuit to measure the current pressure and one circuit to measure the brake oil's temperature. The HECU(Hydraulic and Electronic Control Unit) compares two signals of the pressure sensor and if it differs with normal range, the HECU (Hydraulic and Electronic Control Unit) would judge that the pressure sensor has a fault. The sensor's output is an analog signal to be proportional to the supply voltage. The HECU(Hydraulic and Electronic Control Unit) measures the pressure value by the ratio of signal voltage to supply voltage. In a case of SCC(Smart Cruise Control) system applied, the two more pressure sensors are added to measure the brake oil's pressure of wheel.

DTC Description

The HECU monitors the signal of pressure sensor and if the signal is out of the normal range, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal monitoring	• Open or short in the pressure sensor circuit • Faulty pressure sensor(HECU)
Threshold value	• when the output signal of the pressure sensor is out of the normal range(0.2 ~ 4.8 V)	
Fail-Safe	• The ESP function is inhibited. • The ESP warning lamp is activated.	

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Check if the pressure sensor's service data shows '0 bar' on the scantool while not pressing the brake pedal.
6. Check if the pressure sensor's service data rises on the scantool while pressing the brake pedal.
7. Is the pressure sensor's data unusually shown?

YES ► Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault is intermittently caused by pressure sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Repeat that the brake pedal is pressed and released.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

BR-118

Brake System

C1237 Primary Pressure Sensor-Signal

General Description

The pressure sensor is installed in the HECU (Hydraulic and Electronic Control Unit) in the purpose of sensing the driver's braking intention. This sensor has two circuit to measure the current pressure and one circuit to measure the brake oil's temperature. The HECU (Hydraulic and Electronic Control Unit) compares two signals of the pressure sensor and if it differs with normal range, the HECU (Hydraulic and Electronic Control Unit) would judge that the pressure sensor has a fault. The sensor's output is an analog signal to be proportional to the supply voltage. The HECU (Hydraulic and Electronic Control Unit) measures the pressure value by the ratio of signal voltage to supply voltage. In a case of SCC (Smart Cruise Control) system applied, the two more pressure sensors are added to measure the brake oil's pressure of wheel.

DTC Description

The HECU monitors the signal of pressure sensor and if the signal offset of the pressure sensor/ the signal noises/ the difference between two signals increases above a certain value, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	Signal offset monitoring	Faulty pressure sensor (HECU)
	Threshold value	when the absolute value of signal offset is above 8.0 bar	
	Fail-Safe	- The ESP function is inhibited. - The ESP warning lamp is activated.	
Case 2	DTC Strategy	Noise monitoring	
	Threshold value	when the total of signal noises is continuously above 195 mV	
	Fail-Safe	The BAS function is inhibited.	
Case 3	DTC Strategy	Signal monitoring	
	Threshold value	when the difference between two signals is continuously above a certain value	
	Fail-Safe	- The ESP function is inhibited. - The ESP warning lamp is activated.	

ESP(Electronic Stability Program) System

BR-119

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Check if the pressure sensor's service data shows '0 bar' on the scantool while not pressing the brake pedal.
6. Check if the pressure sensor's service data rises on the scantool while pressing the brake pedal.
7. Is the pressure sensor's data unusually shown?

YES ▶ Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ This fault is intermittently caused by pressure sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Repeat that the brake pedal is pressed and released.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-120

Brake System

C1260 Steering Angle Sensor Circuit-Signal

General Description

The Steering Angle Sensor(SAS) uses two sensors (A-sensor and B-sensor) to determine the direction of the rotation of the wheel. The main component of each sensor is LED, photo transistor and slit plate.

The slit plate, which has 45 holes, is installed between LED and photo transistor, and generates signals if the slit plate rotates according to the steering wheel rotation. The steering angle sensor's signals are generated by photo transistor which is driven whenever the light passes through the holes. The HECU receives the steering signals from steering angle sensor by CAN communication and detects the operating speed and the direction of the steering wheel.

DTC Description

The HECU monitors the signal of the steering angle sensor for a normal operation and if it is detected that there is an error in the sensor's status, this DTC is set.

DTC Detecting Condition

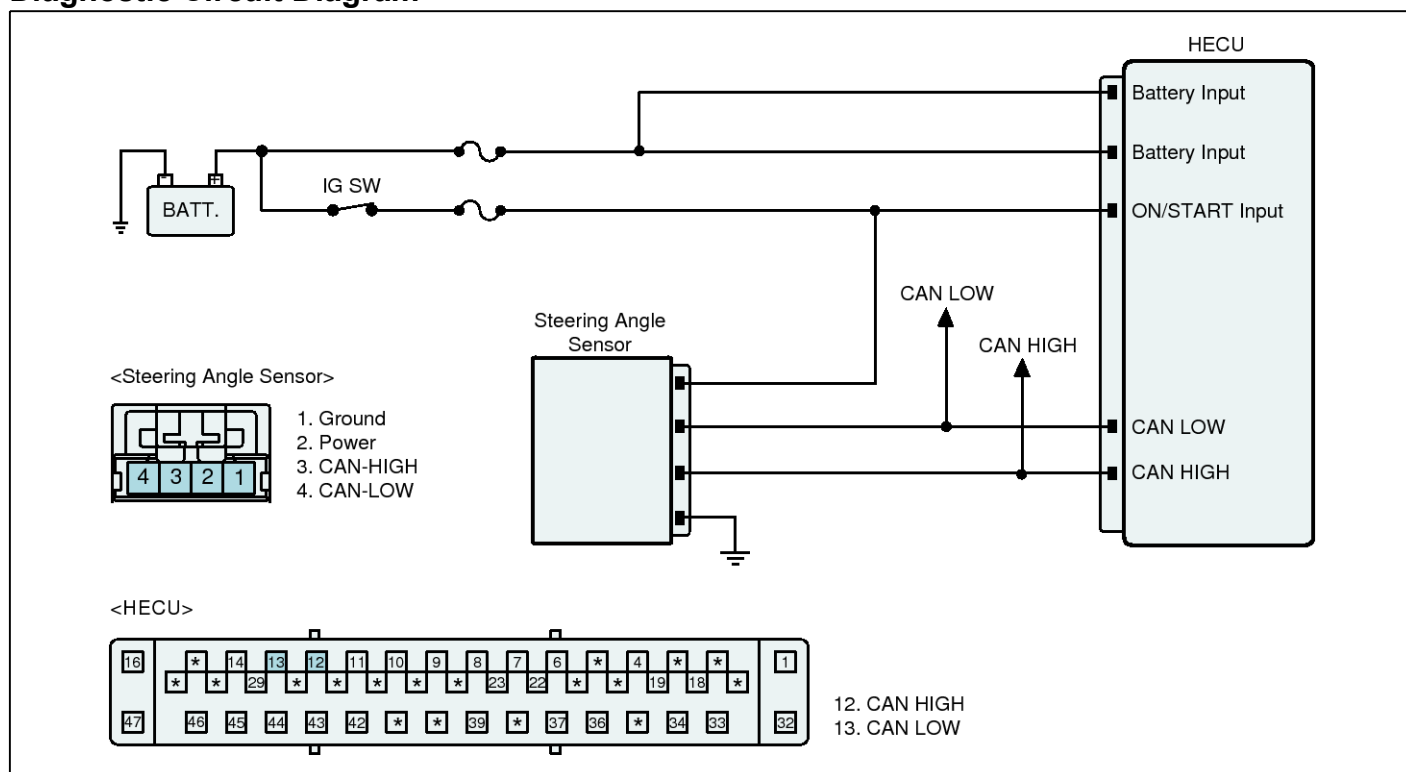
Item		Detecting Condition	Possible Cause
Case 1	DTC Strategy	• Sensor status monitoring	• Open or short in the steering angle sensor circuit • Improper installation of steering angle sensor • Faulty steering angle sensor
	Threshold value	• when the error in the steering angle sensor is detected	
	Fail-Safe	• The TCS/ESP functions are inhibited. • The ESP warning lamp is activated.	
Case 2	DTC Strategy	• Signal offset monitoring	
	Threshold value	• When the offset value of the calculated steering angle sensor's signal is above 15 degrees	
	Fail-Safe	• The TCS/ESP functions are inhibited. • The ESP warning lamp is activated.	
Case 3	DTC Strategy	• Signal monitoring	
	Threshold value	• When the difference between the reference value and the signal value of the steering angle sensor is above a certain value	
	Fail-Safe	• The TCS/ESP functions are inhibited. • The ESP warning lamp is activated.	

※ In a case that the vehicle goes more than a certain distance after the incorrect steering angle sensor's calibration done, this DTC may be set.

ESP(Electronic Stability Program) System

BR-121

Diagnostic Circuit Diagram



SBHBR9506L

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ This fault may be caused by an improper installation of a steering angle sensor.
▶ Check the installation status of the sensor and then, if a problem is detected, repair as necessary and go to "Verification of Vehicle Repair" procedure.
▶ If a problem is not detected, Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

■ Check CAN communication line

- IG "OFF"
- Disconnect steering angle sensor connector and HECU connector.
- Measure resistance between CAN-High terminal of the steering angle sensor harness connector and CAN-High terminal of the HECU harness connector.
- Measure resistance between CAN-Low terminal of the steering angle sensor harness connector and CAN-Low terminal of the HECU harness connector.

Specification : Below approx. 1Ω

- Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in the CAN communication line between HECU and steering angle sensor and then go to "Verification of Vehicle Repair" procedure.

BR-122

Brake System

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Operate the steering angle sensor's calibration by scantool.
6. Check if the signal value of the steering angle sensor is within $\pm 2^\circ$ when the angle of the tire is 0° on the scantool.
7. Is the value of the steering angle sensor out of the normal range?

YES ▶ Substitute with a known-good steering angle sensor and check for proper operation. If problem is corrected, replace steering angle sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing the steering angle sensor, operate the steering angle sensor's calibration by scantool.

NO ▶ This fault is intermittently caused by the steering angle sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-123

C1261 Steering Angle Sensor Not Calibrated

General Description

The Steering Angle Sensor(SAS) uses two sensors (A-sensor and B-sensor) to determine the direction of the rotation of the wheel. The main component of each sensor is LED, photo transistor and slit plate.

The slit plate, which has 45 holes, is installed between LED and photo transistor, and generates signals if the slit plate rotates according to the steering wheel rotation. The steering angle sensor's signals are generated by photo transistor which is driven whenever the light passes through the holes. The HECU receives the steering signals from steering angle sensor by CAN communication and detects the operating speed and the direction of the steering wheel.

DTC Description

The steering angle sensor in the ESP system is an absolute angle sensor type. For this reason, the steering angle sensor needs the zero setting(Calibration) by the scantool. If the calibration of this sensor is undone, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal monitoring	- Calibration not completed - Faulty steering angle sensor - Faulty HECU
Threshold value	when the calibration of the steering angle sensor has not completed	
Fail-Safe	- The TCS/ESP functions are inhibited. - The ESP warning lamp is activated.	

Monitor Scantool Data

- Line up wheels like figure 1.
 - Perform the wheel alignment.
 - Line up the wheel in a straight.
 - Drive the vehicle ahead and back 2~3 times without holding steering wheel.

- Connect scantool to Data Link Connector(DLC).
- Perform steering angle sensor calibration.(Figure 2)
- Disconnect scantool.
- Check the condition of SAS zero point adjustment by driving the vehicle to right-turn and left-turn at least one time.

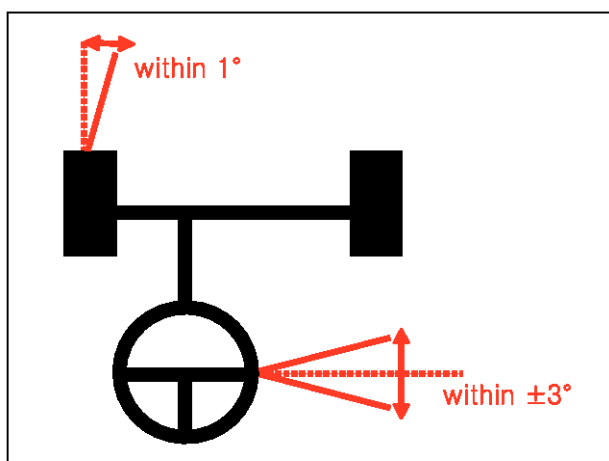


Fig.1

SBHBR9601L

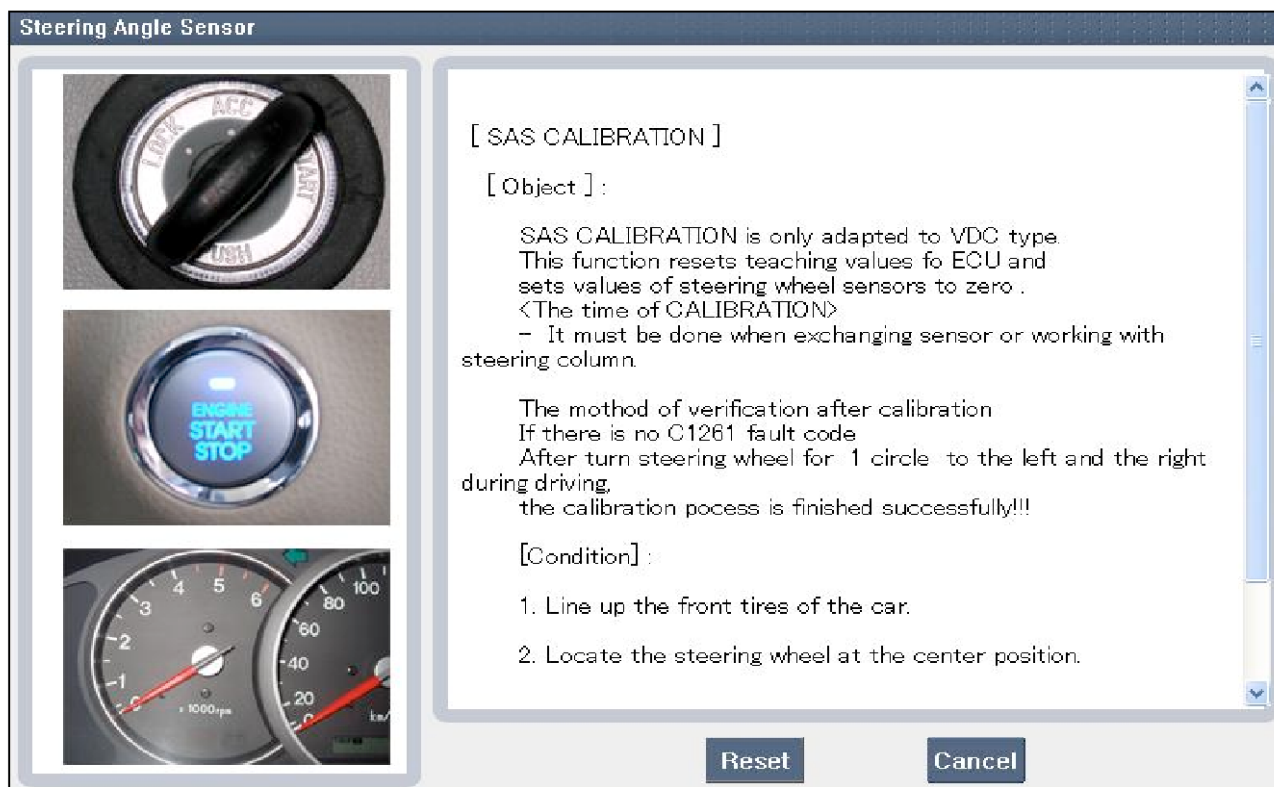


Fig.2

SBHBR9602L

6. Is the calibration(zero point adjustment) completed?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-125

C1274 Longitudinal G Sensor-Electrical

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the Longitudinal G sensor is installed on the lower of the center console. This sensor is used for EPB control. In a case of EPB(Electric Parking Brake) system applied on the vehicle, the yaw-rate sensor, longitudinal G sensor and lateral G sensor are installed together in the one container which is called as "Cluster". The HECU recognizes the gradient of an incline by this longitudinal G sensor's signal.

DTC Description

The HECU monitors the signal of the longitudinal G sensor for a normal operation and if its signal is detected out of the normal range, this DTC is set.

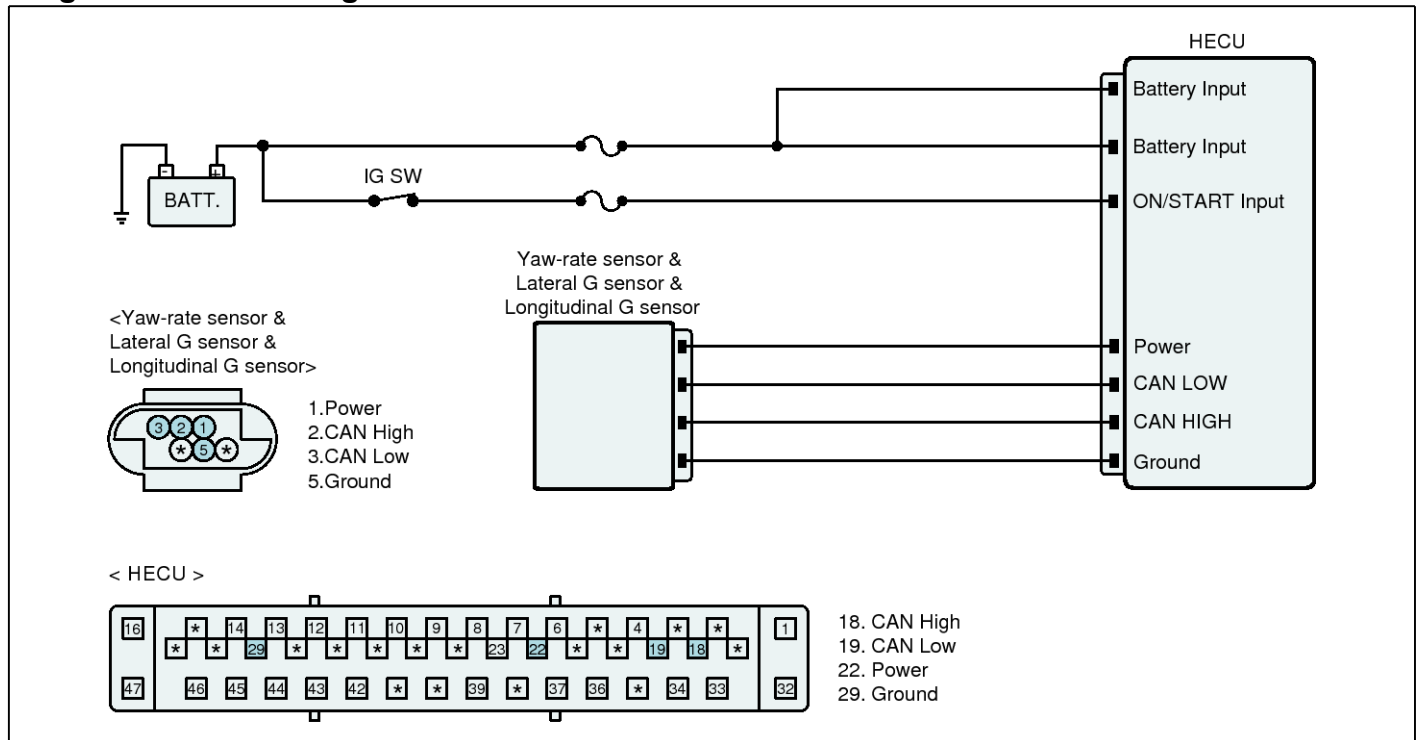
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal monitoring	- Open or short in the longitudinal G Sensor circuit - Faulty the longitudinal G sensor (Installed in the yaw-rate sensor & lateral G sensor & longitudinal G sensor)
Threshold value	when the output signal of the longitudinal G sensor is out of the normal range	
Fail-Safe	- The AVH(Automatic Vehicle Hold) function is inhibited. - Warning lamp "OFF"	

BR-126

Brake System

Diagnostic Circuit Diagram



SBHBR9507L

Monitor Scantool Data

1. Stop the vehicle on the ground.
2. IG "ON"

3. Check the service data related to "Longitudinal G sensor" on the scantool.

Specification : Approx. $\pm 0.01G$

Sensor Name	Value	Unit
☒ G-Sensor Longitudinal	-0.0	-

Fig.1

SBHBR9603L

Fig.1) Normal service data at IG "ON"

4. Is the service data normal?

YES ▶ Fault is intermittent caused by poor connection in the sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

ESP(Electronic Stability Program) System

BR-127

Power Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. Measure resistance between power terminal of the Yaw-rate & Lateral G & Longitudinal G sensor harness connector and power terminal of the HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in power circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. Measure resistance between ground terminal of the Yaw-rate & Lateral G & Longitudinal G sensor harness connector and ground terminal of the HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open in ground circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. IG "ON"
4. Measure resistance between CAN-High terminal of the sensor harness connector and CAN-High terminal of the HECU harness connector.
5. Measure resistance between CAN-Low terminal of the sensor harness connector and CAN-Low terminal of the HECU harness connector.

Specification : Below approx. 1Ω

6. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. Measure resistance between CAN-High terminal and CAN-Low terminal of the sensor harness connector.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good Yaw-rate & Lateral G & Longitudinal G sensor and check for proper operation. If problem is corrected, replace Yaw-rate & Lateral G & Longitudinal G sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing the Yaw-rate & Lateral G & Longitudinal G sensor, operate the sensor's calibration by scantool.

NO ▶ Repair short in signal circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle on the ground level and on the incline.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-128

Brake System

C1275 Longitudinal G Sensor Range/Performance error

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the Longitudinal G sensor is installed on the lower of the center console. This sensor is used for EPB control. In a case of EPB(Electric Parking Brake) system applied on the vehicle, the yaw-rate sensor, longitudinal G sensor and lateral G sensor are installed together in the one container which is called as "Cluster". The HECU recognizes the gradient of an incline by this longitudinal G sensor's signal.

DTC Description

The HECU monitors the signal of the longitudinal G sensor for a normal operation and if the abnormal signal is detected or the difference between the acceleration value calculated from the changes of vehicle speed and the the acceleration value measured from the sensor is above a certain value, this DTC is set.

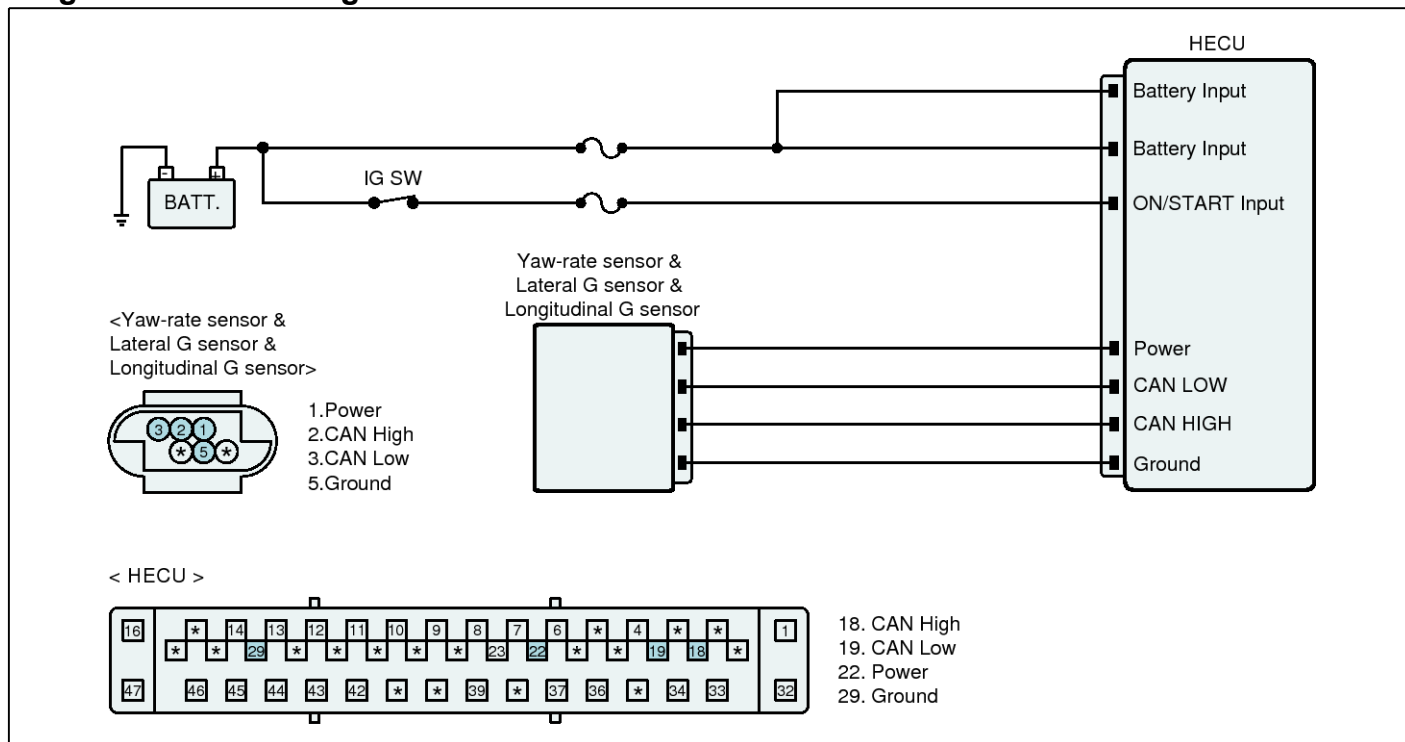
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal monitoring	- Improper installation of the longitudinal G sensor - Faulty the longitudinal G sensor (Installed in the yaw-rate sensor & lateral G sensor & longitudinal G sensor)
Threshold value	- when the calculated acceleration by wheel speed sensor differs with the measured acceleration by the longitudinal G sensor - This is monitored when the difference between the maximum wheel speed and the minimum wheel speed is less than 3 kph at the constant speed driving.	
Fail-Safe	- The AVH(Automatic Vehicle Hold) function is inhibited. - Warning lamp "OFF"	

ESP(Electronic Stability Program) System

BR-129

Diagnostic Circuit Diagram



SBHBR9507L

Monitor Scantool Data

1. Stop the vehicle on the ground.
2. IG "ON"

3. Check the service data related to "Longitudinal G sensor" on the scantool.

Specification : Approx. $\pm 0.01G$

Sensor Name	Value	Unit
☒ G-Sensor Longitudinal	-0.0	-

Fig.1

SBHBR9603L

Fig.1) Normal service data at IG "ON"

4. Is the service data normal?

YES ► Fault is intermittent caused by poor connection in the sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► This fault may be caused by an improper installation of the sensor. Check the installation status of the sensor and then, if a problem is detected, repair as necessary and go to "Verification of Vehicle Repair" procedure.
► If a problem is not detected, Go to "Component Inspection" procedure.

BR-130

Brake System

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Check if the longitudinal acceleration value is within $\pm 0.01G$ on the ground level by scantool.
6. Is the value of the longitudinal acceleration value out of the normal range?

YES ▶ Substitute with a known-good the longitudinal G sensor and check for proper operation. If problem is corrected, replace the longitudinal G sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing the yaw-rate & longitudinal G & lateral G sensor, operate the sensor's calibration by scantool.

NO ▶ This fault is intermittently caused by the sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle on the ground level and on the incline.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-131

C1282 Yaw Rate & Lateral G Sensor-Electrical

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the yaw-rate & lateral G sensor is installed on the lower of the center console. The yaw-rate and the lateral G sensor are installed together in the one container which is called as "Cluster". When the vehicle is moving around a vertical axis, the yaw rate sensor senses the vibration changes of the plate-fork installed in the yaw-rate sensor. When the vehicle's yawing is sensed and the yaw velocity reaches a certain velocity, the ESP control is activated. The lateral G sensor senses a vehicle's lateral acceleration. A small element in the sensor is attached to a deflectable lever-arm. The HECU recognizes a vehicle's direction and a lateral acceleration by the lateral G sensor.

DTC Description

The HECU monitors the signals of the yaw-rate and the lateral G sensor and if its signals are detected out of the normal range, this DTC is set.

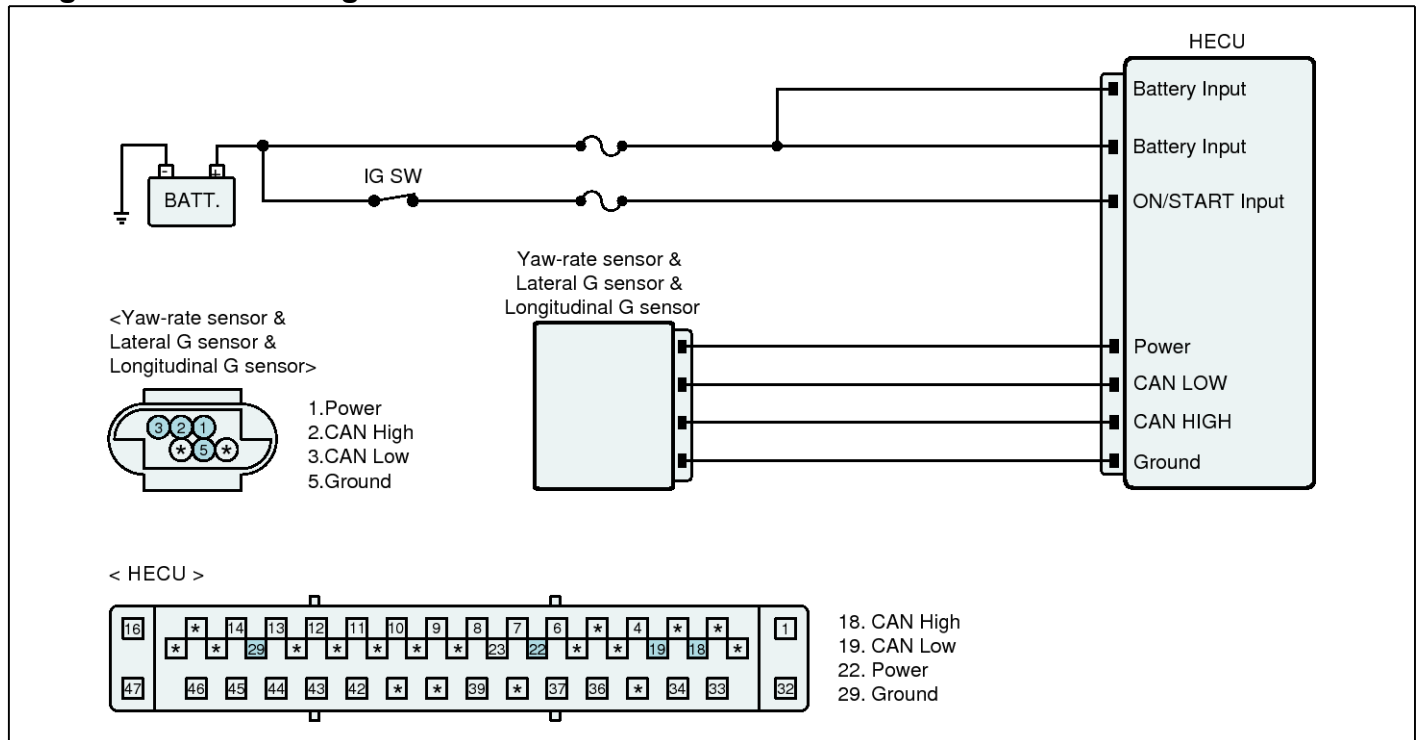
DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Signal monitoring	- Open or short in the yaw-rate and the lateral G sensor circuit - Faulty yaw-rate and lateral G sensor (Installed in the yaw-rate sensor & lateral G sensor & longitudinal G sensor)
Threshold value	Case 1	When the ignition voltage is above 18V or below 6.5V for more than a certain period	
	Case 2	When there is a fault in the sensor	
	Case 3	When the output of the lateral G sensor is out of the normal range	
	Case 4	When the output of the yaw-rate sensor is out of the normal range	
	Case 5	When the CAN bus-off is detected or when the CAN messages are not detected for a certain period.	
Fail-Safe		- The TCS/ESP/SCC/AVH functions are inhibited. - The ESP warning lamp is activated.	

BR-132

Brake System

Diagnostic Circuit Diagram



SBHBR9507L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON"

3. Check the service data related to "Yaw-rate and Lateral G sensor" on the scantool.

Specification : Approx. $\pm 0.01G$

Sensor Name	Value	Unit
☒ G-Sensor Lateral	-0.0	G

Fig.1

SBHBR9604L

Fig.1) Normal service data at IG "ON"

4. Is the service data normal?

YES ▶ Fault is intermittent caused by poor connection in the sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

ESP(Electronic Stability Program) System

BR-133

Power Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. Measure resistance between power terminal of the Yaw-rate & Lateral G & Longitudinal G sensor harness connector and power terminal of the HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in power circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. Measure resistance between ground terminal of the Yaw-rate & Lateral G & Longitudinal G sensor harness connector and ground terminal of the HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open in ground circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. IG "ON"
4. Measure resistance between CAN-High terminal of the sensor harness connector and CAN-High terminal of the HECU harness connector.
5. Measure resistance between CAN-Low terminal of the sensor harness connector and CAN-Low terminal of the HECU harness connector.

Specification : Below approx. 1Ω

6. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect Yaw-rate & Lateral G & Longitudinal G sensor connector and HECU connector.
3. Measure resistance between CAN-High terminal and CAN-Low terminal of the sensor harness connector.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good Yaw-rate & Lateral G & Longitudinal G sensor and check for proper operation. If problem is corrected, replace Yaw-rate & Lateral G & Longitudinal G sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing the Yaw-rate & Lateral G & Longitudinal G sensor, operate the sensor's calibration by scantool.

NO ▶ Repair short in signal circuit between the sensor and HECU and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-134

Brake System

C1283 Yaw Rate & Lateral G Sensor-Signal

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the yaw-rate & lateral G sensor is installed on the lower of the center console. The yaw-rate and the lateral G sensor are installed together in the one container which is called as "Cluster". When the vehicle is moving around a vertical axis, the yaw rate sensor senses the vibration changes of the plate-fork installed in the yaw-rate sensor. When the vehicle's yawing is sensed and the yaw velocity reaches a certain velocity, the ESP control is activated. The lateral G sensor senses a vehicle's lateral acceleration. A small element in the sensor is attached to a deflectable lever-arm. The HECU recognizes a vehicle's direction and a lateral acceleration by the lateral G sensor.

DTC Description

The HECU monitors the signals of the yaw-rate and the lateral G sensor and if the abnormal signal is detected or the difference between the acceleration value calculated from the changes of vehicle speed and the the acceleration value measured from the sensor is above a certain value, this DTC is set.

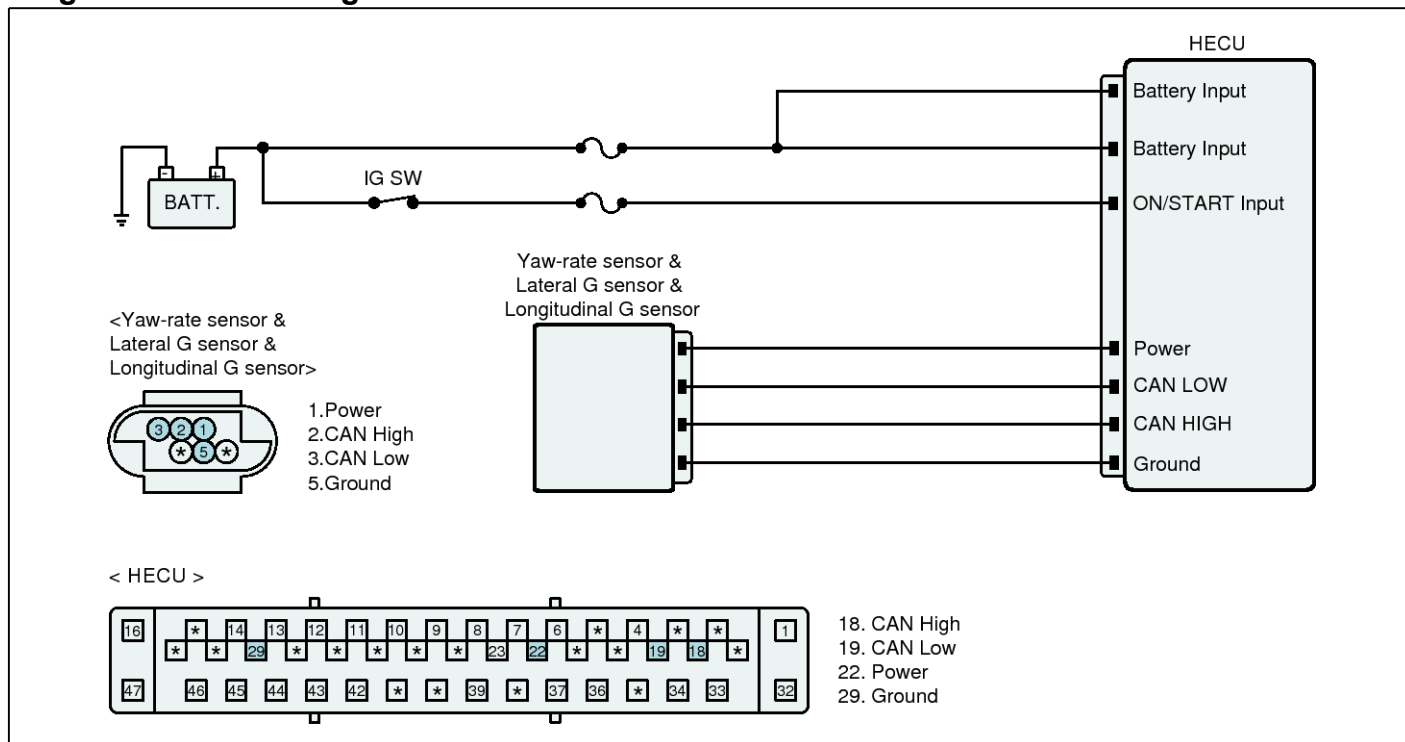
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal monitoring	- Improper installation of the yaw-rate and lateral G sensor - Faulty the yaw-rate and lateral G sensor (Installed in the yaw-rate sensor & lateral G sensor & longitudinal G sensor)
Threshold value	when the calculated acceleration by wheel speed sensor differs with the measured acceleration by the lateral G sensor under a constant speed driving or the abnormal signal is detected.	
Fail-Safe	- The TCS/ESP/SCC/AVH functions are inhibited. - The ESP warning lamp is activated.	

ESP(Electronic Stability Program) System

BR-135

Diagnostic Circuit Diagram



SBHBR9507L

Monitor Scantool Data

1. Connect santool to Data Link Connector(DLC).
2. IG "ON"

3. Check the service data related to "Yaw-rate and Lateral G sensor" on the scantool.

Specification : Approx. $\pm 0.01G$

Sensor Name	Value	Unit
☒ G-Sensor Lateral	-0.0	G

Fig.1

SBHBR9604L

Fig.1) Normal service data at IG "ON"

4. Is the service data normal?

YES ► Fault is intermittent caused by poor connection in the sensor harness and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► This fault may be caused by an improper installation of the sensor. Check the installation status of the sensor and then, if a problem is detected, repair as necessary and go to "Verification of Vehicle Repair" procedure.
► If a problem is not detected, Go to "Component Inspection" procedure.

BR-136

Brake System

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Using a scantool, Check DTC present.
6. Is the same DTC shown?

YES ▶ Substitute with a known-good Yaw-rate & Lateral G & Longitudinal G sensor and check for proper operation. If problem is corrected, replace Yaw-rate & Lateral G & Longitudinal G sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing the Yaw-rate & Lateral G & Longitudinal G sensor, operate the sensor's calibration by scantool.

NO ▶ This fault is intermittently caused by the sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-137

C1503 TCS/ESC(ESP) Switch error

General Description

A Driver can suspend the ESP function by ESP OFF switch. When this switch signal is delivered into the HECU, the ESP warning lamp is turned on and the ESP control is stopped. When the next switch signal is inputted again, the ESP function is ready. This function is used for sporty driving or vehicle inspection.

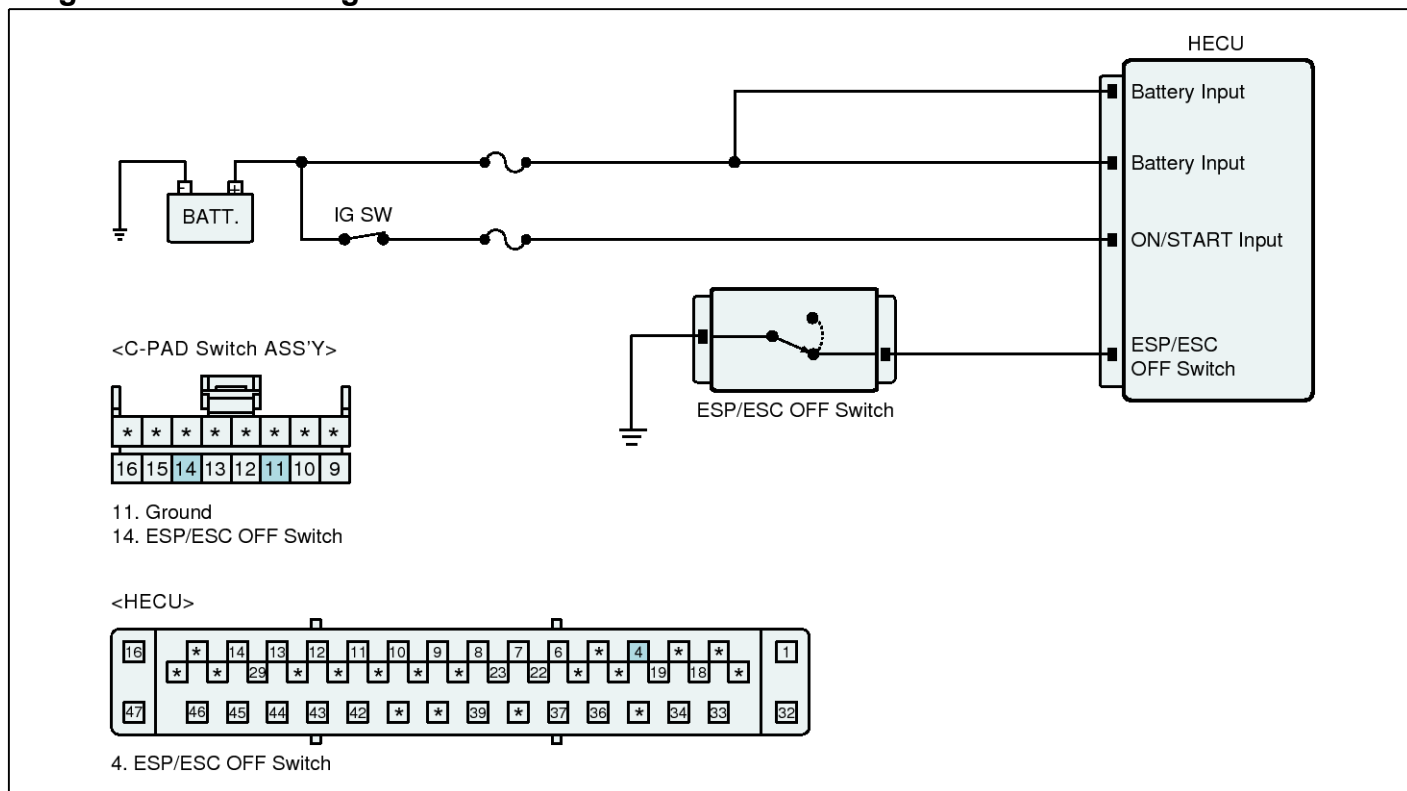
DTC Description

The HECU monitors the ESP OFF switch signal and if the ESP OFF switch signal is inputted for more than 1 minute, This DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal monitoring	- Short in the ESP OFF switch circuit - Faulty ESP OFF switch
Threshold value	When the ESP OFF switch signal is inputted for more than 60 seconds	
Fail-Safe	ESP OFF mode is canceled	

Diagnostic Circuit Diagram



SBHBR9508L

BR-138

Brake System

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect ESP OFF Switch connector and HECU connector.
3. Measure resistance between signal terminal of the ESP OFF switch harness connector and signal terminal of the HECU harness connector.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Check for short in harness" procedure.

NO ▶ Repair open in signal circuit between the ESP OFF switch and HECU and then go to "Verification of vehicle Repair" procedure.

■ Check for short in harness

1. IG "OFF"
2. Disconnect ESP OFF Switch connector and HECU connector.
3. Measure resistance between signal terminal of the ESP OFF switch harness connector and chassis ground.

Specification : Infinite

4. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair short in signal circuit between the ESP OFF switch and HECU and then go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Check for open in harness

1. IG "OFF"
2. Disconnect ESP OFF Switch connector and HECU connector.
3. Measure resistance between ground terminal of the ESP OFF switch harness connector and chassis ground.

Specification : Below approx. 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in ground circuit between the ESP OFF switch and chassis ground and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Check ESP OFF Switch

1. IG "OFF"
2. Disconnect ESP OFF Switch connector.
3. Press the ESP OFF Switch.
4. Measure resistance between both ends of the ESP OFF Switch connector while pressing the button.

Specification : Below approx. 1.0Ω

5. Is the measured value within specifications?

YES ▶ This fault may be intermittently caused by a poor connection of the ESP OFF switch. Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good ESP OFF Switch and check for proper operation. If problem is corrected, replace ESP OFF Switch and then go to "Verification of Vehicle Repair" procedure.

ESP(Electronic Stability Program) System

BR-139

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

BR-140

Brake System

C1513 Brake switch error

General Description

This brake light switch is mounted on the brake-pedal assembly and is used to indicate the status of brake pedal to the HECU. This switch is the normal-open type and is closed when the brake-pedal is pressed. And when the brake-pedal is released, the switch is opened. The HECU uses this as the basic signal to recognize a driver's intention for braking.

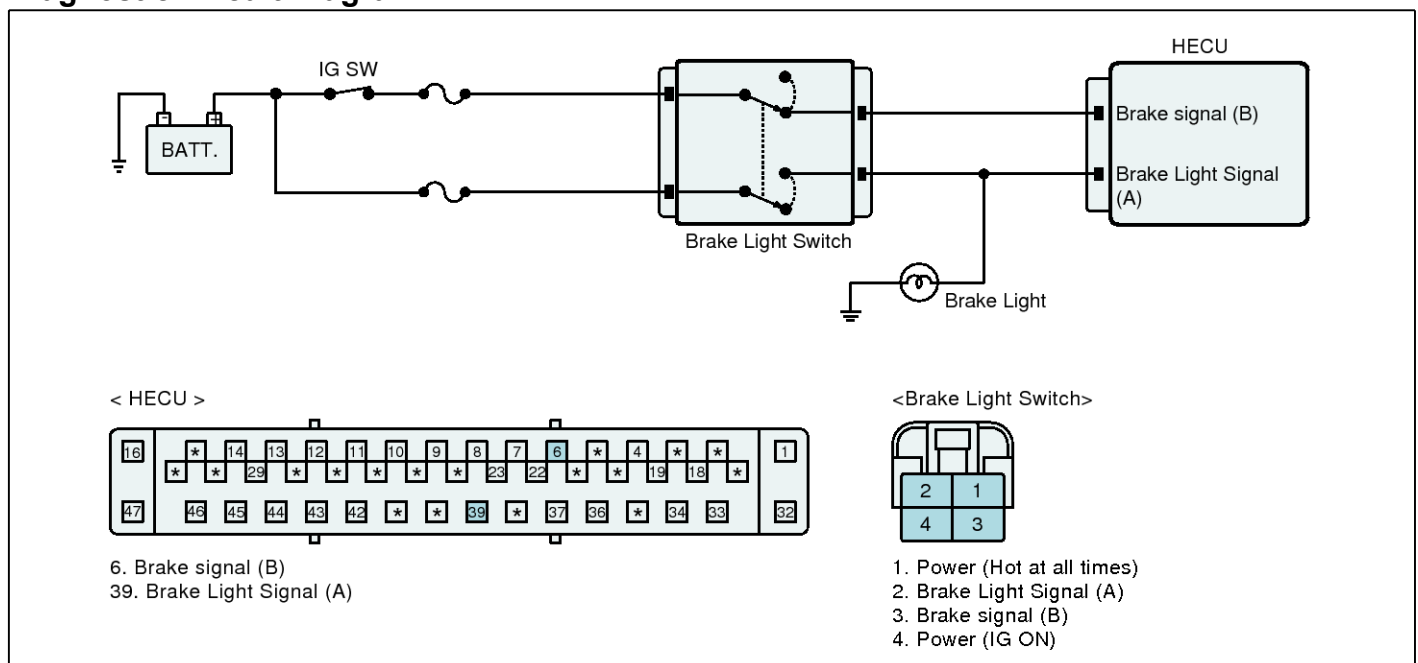
DTC Description

The HECU monitors the brake light switch circuit for a normal operation and if it has a open or short circuit, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitoring the brake switch signal	- Open or short in the brake light switch circuit - Faulty brake light switch
Threshold value	- When there is no change in the brake light switch's signal but the signal of pressure sensor is being increased - When the brake light switch's signal is continuously inputted for more than 4 minutes at above 20 km/h(12.4 MPH) - When there is no change of the brake light switch's signal with a vehicle repeating from the acceleration of above 40 km/h(24.8 MPH) to the deceleration of below 3 km/h(1.8 MPH) several times	
Fail-Safe	The SCC(Smart Cruise Control)/ AVH(Automatic Vehicle Hold) functions are inhibited.	

Diagnostic Circuit Diagram



SBHBR9509L

ESP(Electronic Stability Program) System

BR-141

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON"
3. Press a brake-pedal.
4. Check the service data related to "Brake Switch" on the scantool.

Specification : The brake switch's signal changes from OFF to ON.

5. Does the service data change normally?

YES ▶ Fault is intermittent caused by poor connection in the brake light switch and/or HECU's connector or was repaired and HECU memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal Circuit Inspection (In case of brake-pedal released)" procedure.

Signal Circuit Inspection (In case of brake-pedal released)

■ Check for open or short in harness

1. IG "ON"
2. Measure voltage between signal terminal of the HECU harness connector and chassis ground.

Specification : Brake Light Signal(A) - 0V
Brake Signal(B) - Battery voltage

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection (In case of brake-pedal pressed)" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection (In case of brake-pedal pressed)

■ Check for open or short in harness

1. IG "ON"
2. Measure voltage between signal terminal of the HECU harness connector and chassis ground.

Specification : Brake Light Signal(A) - Battery voltage
Brake Signal(B) - 0V

3. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open or short in signal circuit between the battery(+) and HECU and then go to "Verification of vehicle Repair" procedure.

BR-142

Brake System

Component Inspection

■ Check brake light switch

1. IG "OFF"
2. Disconnect brake light switch connector.
3. Measure resistance between both ends of the brake light switch connector.

Specification :

Resistance between both ends of the Brake Light Switch (A)

- 0Ω (when the brake light switch is pressed) $\infty\Omega$ (when the brake light switch is released)

Resistance between both ends of the Brake Switch(B)

- $\infty\Omega$ (when the brake light switch is pressed) 0Ω (when the brake light switch is released)

4. Is the measured value within specifications?

YES ► Fault is intermittently caused by poor connection in brake light switch harness and/or HEC-U's connector. Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known-good brake light switch and check for proper operation.
If problem is corrected, replace brake light switch and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Repeat that the brake pedal is pressed and released.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-143

C1604 ECU Hardware Error

General Description

The HECU consists of an ECU (Electronic Control Unit) and a HCU(Hydraulic Control Unit). The HCU portion of the assembly contains a pump motor, solenoid valves, and accumulator. Raising and reducing the pressure of brake oil is completed by the electronic motor, according to a measured signal by wheel speed sensor. The function of HCU is to increase, decrease or maintain the hydraulic pressure supplied to a wheel cylinder by operating a return pump according to the control logic when the ESP control is active. The ECU monitors various sensors and switch inputs. These inputs are used to make decisions regarding HCU component operation.

DTC Description

The HECU monitors the operation of the IC components such as memory, register, A/D converter and so on.

If HECU can't write or erase data on the EEPROM or it is detected as an error in RAM etc., this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	- When the HECU can't erase or write a data of the EEPROM. - When the master/slave processor detects abnormal operation in RAM, status register, interrupt, timer, A/D converter and cycle time.	
Fail-Safe	- The ABS/EBD/ESP functions are inhibited. - The ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

- Ignition "OFF" & Engine "OFF".
- Ignition "ON" & Engine "OFF".
- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- Using a scantool, Clear DTC.
- Using a scantool, Check DTC present.
- Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU or HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-145

C1605 CAN Hardware error

General Description

The HECU sends the request messages, such as torque reduction and fuel cut, to the ECM and TCM through CAN bus line for TCS control. The Engine ECM carries out the fuel-cut logic according to the request messages from the HECU and it also retards an ignition timing by torque reduction requests. The TCM maintains current gear position during TCS control in order to prevent an acceleration force from rising by a kickdown shift.

DTC Description

The HECU monitors CAN messages for a normal operation and if it is detected as a fault in the CAN hardware, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• CAN monitoring	• Faulty HECU
Threshold value	• When the CAN hardware has an error	
Fail-Safe	• The TCS/ESP/SCC/AVH functions are inhibited. • The ESP warning lamp is activated.	

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ This fault may be intermittently caused by poor connection in the HECU or HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-146

Brake System

C1611 CAN Time-out ECM

General Description

The HECU sends the request messages, such as torque reduction and fuel cut, to the ECM and TCM through CAN bus line for TCS control. The Engine ECM carries out the fuel-cut logic according to the request messages from the HECU and it also retards an ignition timing by torque reduction requests. The TCM maintains current gear position during TCS control in order to prevent an acceleration force from rising by a kickdown shift.

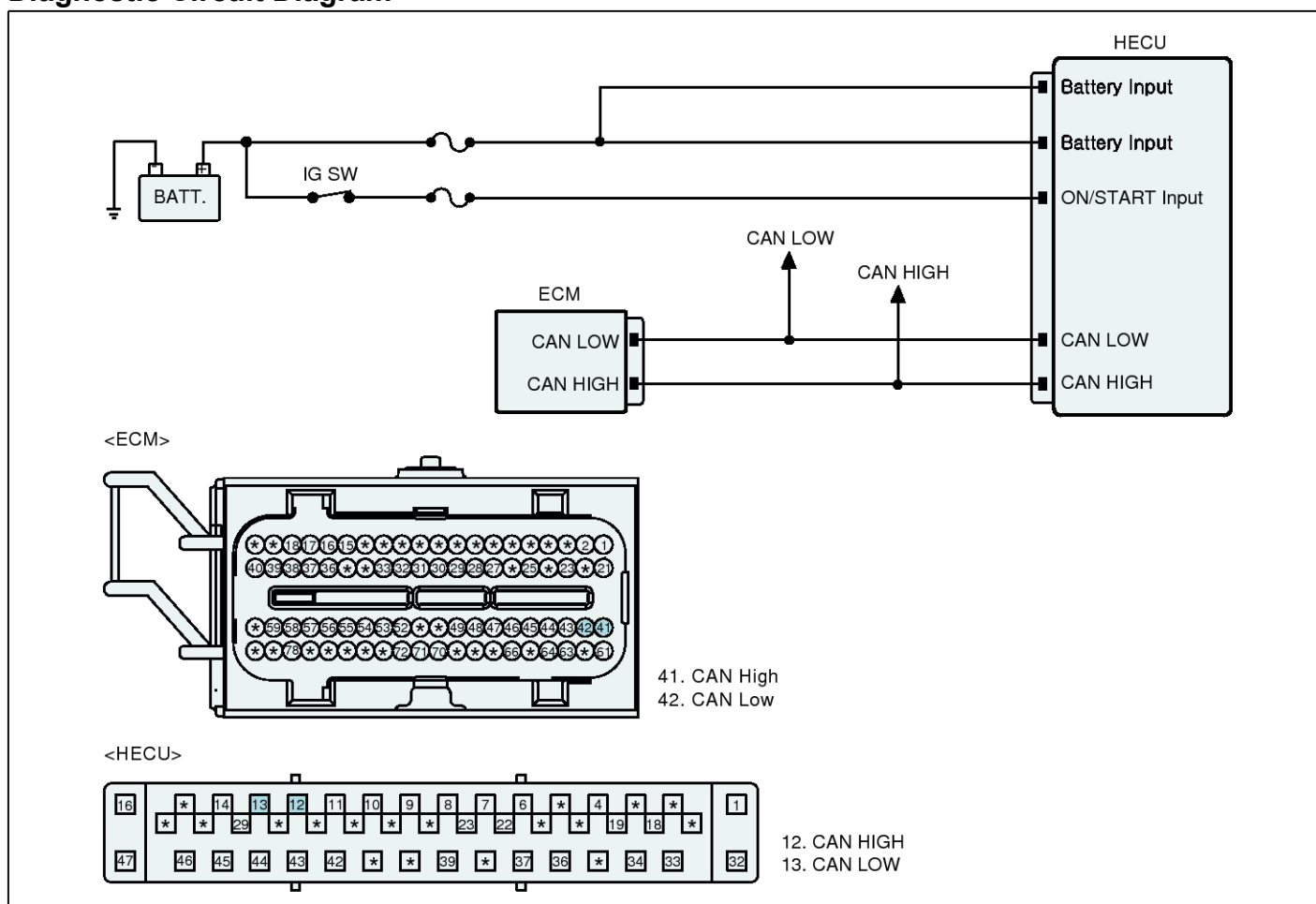
DTC Description

The HECU checks the CAN communication lines for normal control and if an ECM message is not received for a certain period, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	CAN message monitoring	- Faulty ECM - Open or short in CAN communication line
Threshold value	When the ECM messages are not received for more than 0.5 second with a normal voltage condition	
Fail-Safe	- The TCS/ESP/SCC/DBF/AVH functions are inhibited. - The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SBHBR9510L

ESP(Electronic Stability Program) System

BR-147

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "CAN Communication line Inspection" procedure.

CAN Communication line Inspection

■ Check CAN communication line

1. IG "OFF"
2. Disconnect ECM connector and HECU connector.
3. Measure resistance between CAN-High terminal of ECM harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of ECM harness connector and CAN-Low terminal of HECU harness connector.

Specification : Below approx. 1Ω

5. Is the measured value within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in the CAN communication line between ECM and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good ECM/HECU and check for proper operation.
If problem is corrected, replace ECM/HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ This fault may be intermittently caused by poor connection in the ECM or HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-148

Brake System

C1612 CAN Time-out TCM

General Description

The HECU sends the request messages, such as torque reduction and fuel cut, to the ECM and TCM through CAN bus line for TCS control. The Engine ECM carries out the fuel-cut logic according to the request messages from the HECU and it also retards an ignition timing by torque reduction requests. The TCM maintains current gear position during TCS control in order to prevent an acceleration force from rising by a kickdown shift.

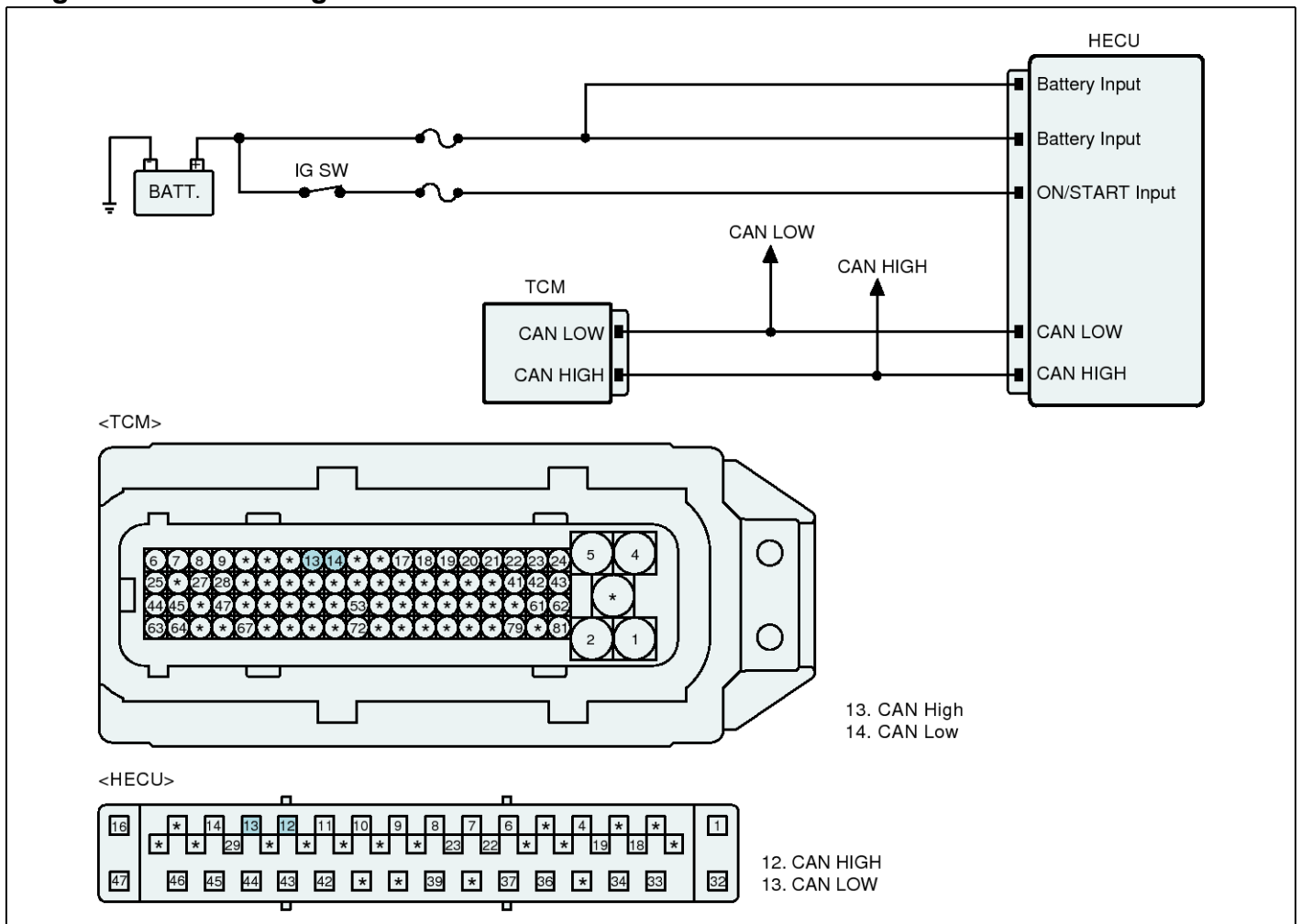
DTC Description

The HECU checks the CAN communication lines for normal operation and if a TCM message is not received for a certain period, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	CAN message monitoring	- Faulty TCM - Open or short in CAN communication line
Threshold value	When the TCM messages are not received for more than 0.5 second with a normal voltage condition	
Fail-Safe	- The TCS/ESP/SCC/DBF/AVH functions are inhibited. - The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "CAN Communication line Inspection" procedure.

CAN Communication line Inspection

■ Check CAN communication line

1. IG "OFF"
2. Disconnect TCM connector and HECU connector.
3. Measure resistance between CAN-High terminal of TCM harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of TCM harness connector and CAN-Low terminal of HECU harness connector.

Specification : Below approx. 1Ω

5. Is the measured value within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in the CAN communication line between TCM and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good TCM/HECU and check for proper operation.
If problem is corrected, replace TCM/HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ This fault may be intermittently caused by poor connection in the TCM or HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-150

Brake System

C1613 CAN signal error ECM (Check ECM)

General Description

The HECU sends the request messages, such as torque reduction and fuel cut, to the ECM and TCM through CAN bus line for TCS control. The Engine ECM carries out the fuel-cut logic according to the request messages from the HECU and it also retards an ignition timing by torque reduction requests. The TCM maintains current gear position during TCS control in order to prevent an acceleration force from rising by a kickdown shift.

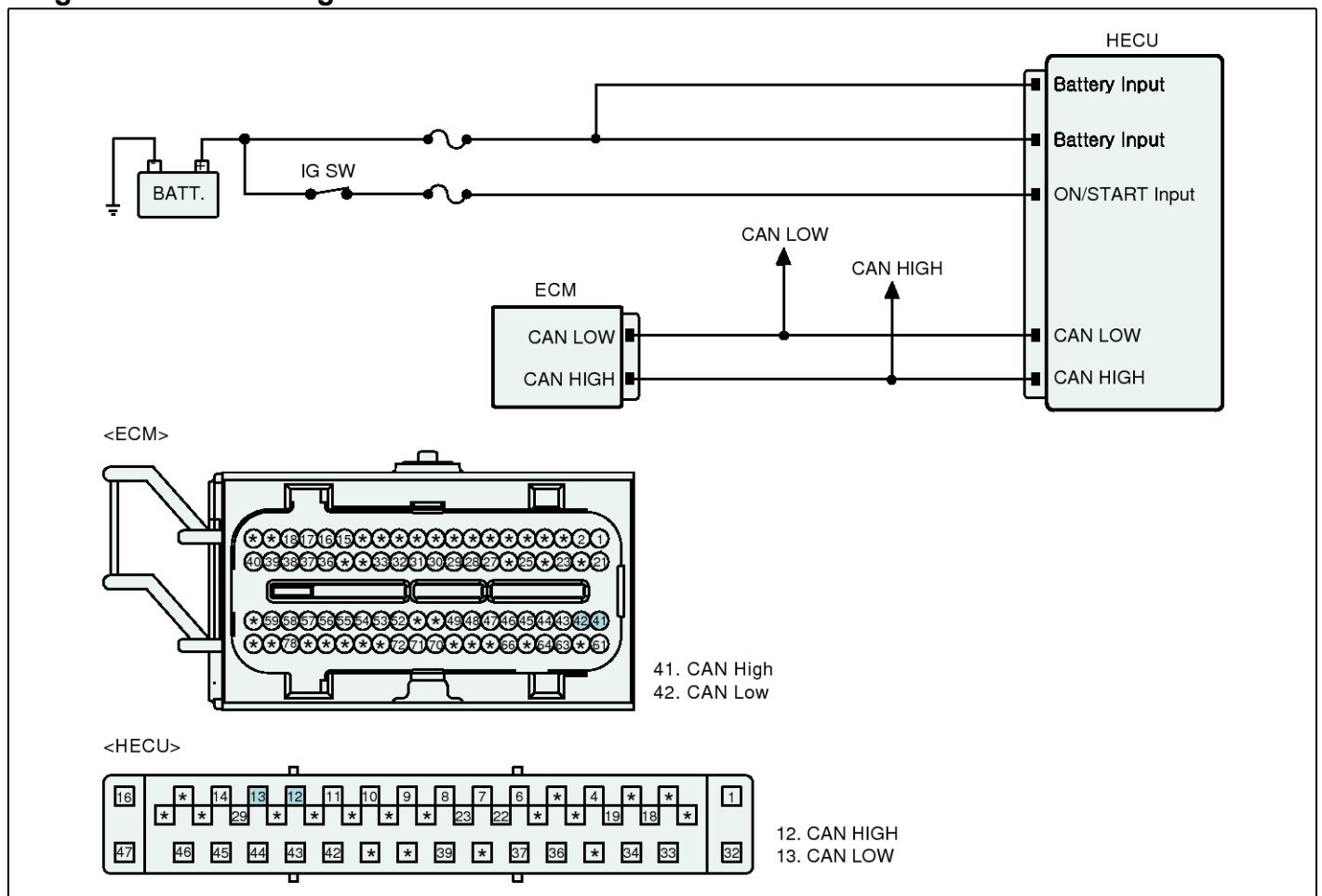
DTC Description

The HECU monitors CAN messages for a normal operation and if the abnormal messages from ECM are detected, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	CAN message monitoring	- A fault in the ECM side - Poor connection of CAN communication circuit
Threshold value	when the abnormal messages are detected	
Fail-Safe	- The TCS/ESP/SCC/AVH functions are inhibited. - The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



ESP(Electronic Stability Program) System

BR-151

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "CAN Communication line Inspection" procedure.

CAN Communication line Inspection

■ Check CAN communication line

1. IG "OFF"
2. Disconnect ECM connector and HECU connector.
3. Measure resistance between CAN-High terminal of ECM harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of ECM harness connector and CAN-Low terminal of HECU harness connector.

Specification : Below approx. 1Ω

5. Is the measured value within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in the CAN communication line between ECM and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ▶ This fault may be caused by an abnormal CAN messages from the engine control unit. Check if there is a problem in the engine side. After repairing the fault of the engine side, Go to "Verification of Vehicle Repair" procedure.

NO ▶ This fault may be intermittently caused by poor connection in the ECM or HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-152

Brake System

C1616 CAN Communication Bus Off

General Description

The HECU sends the request messages, such as torque reduction and fuel cut, to the ECM and TCM through CAN bus line for TCS control. The Engine ECM carries out the fuel-cut logic according to the request messages from the HECU and it also retards an ignition timing by torque reduction requests. The TCM maintains current gear position during TCS control in order to prevent an acceleration force from rising by a kickdown shift.

DTC Description

The HECU monitors CAN communication line and if the CAN BUS OFF happens more than 10 times, this DTC is set.

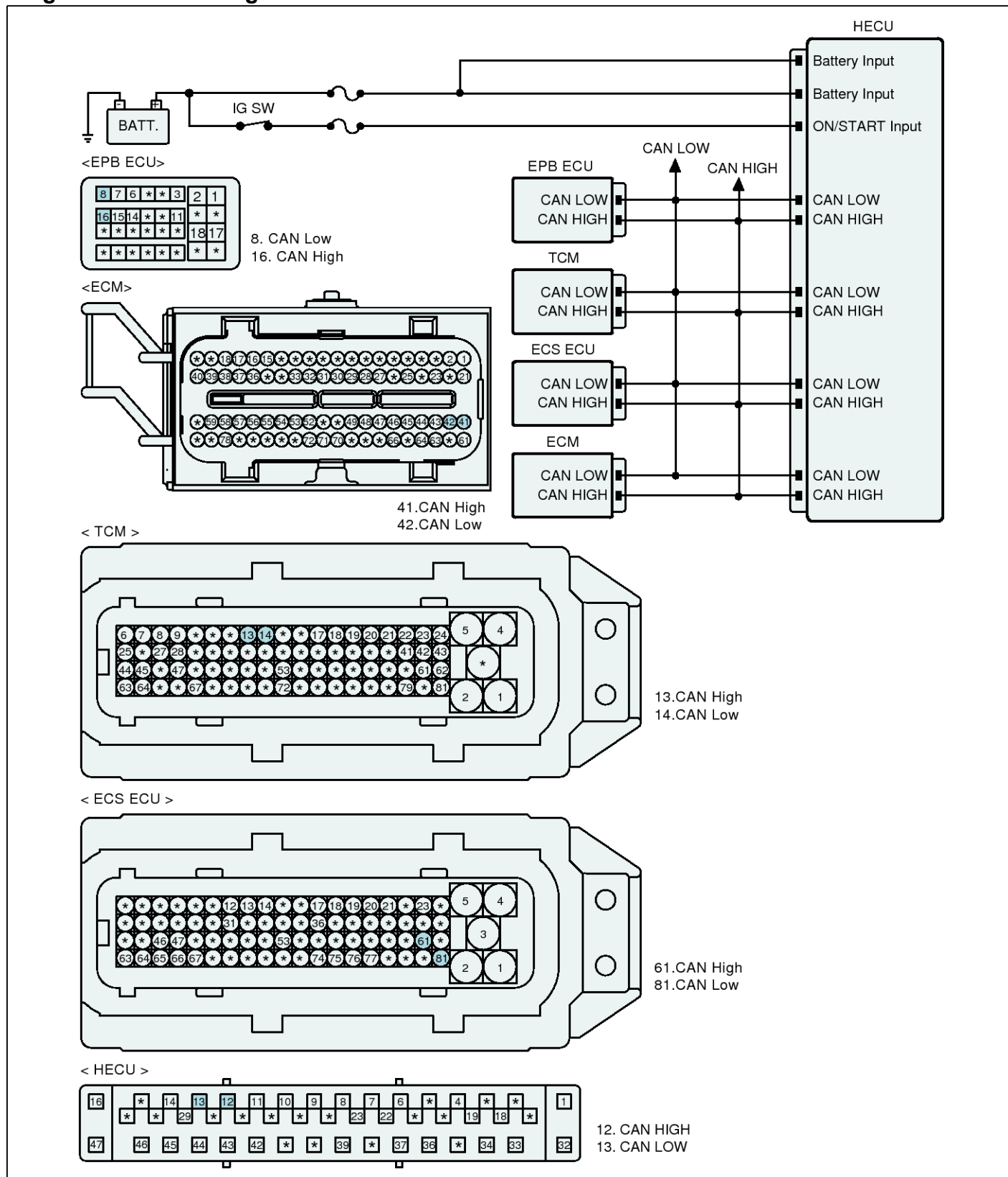
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitoring CAN communication line	- Open or short in the CAN communication line - Faulty HECU
Threshold value	When the CAN bus off takes place over 10 times	
Fail-Safe	- The TCS/ESP/SCC/AVH functions are inhibited. - The ESP warning lamp is activated.	

ESP(Electronic Stability Program) System

BR-153

Diagnostic Circuit Diagram



SBHBR9512L

BR-154

Brake System

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "CAN Communication line Inspection" procedure.

CAN Communication line Inspection

■ Check CAN communication line

1. IG "OFF"
2. Disconnect ECM/ECS ECU/TCM/EPB ECU connector and HECU connector.
3. Measure resistance between CAN-High terminal of ECM/ECS ECU/TCM/EPB ECU harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of ECM/ECS ECU/TCM/EPB ECU harness connector and CAN-Low terminal of HECU harness connector.

Specification : Below approx. 1Ω

5. Is the measured value within specification?

YES ► Go to "Component Inspection" procedure.

NO ► Repair open in the CAN communication line between ECM/ECS ECU/TCM/EPB ECU and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Using a scantool, Check DTC present.
4. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-155

C1623 CAN Time-out Steering Angle Sensor

General Description

The Steering Angle Sensor(SAS) uses two sensors (A-sensor and B-sensor) to determine the direction of the rotation of the wheel. The main component of each sensor is LED, photo transistor and slit plate.

The slit plate, which has 45 holes, is installed between LED and photo transistor, and generates signals if the slit plate rotates according to the steering wheel rotation. The steering angle sensor's signals are generated by photo transistor which is driven whenever the light passes through the holes. The HECU receives the steering signals from steering angle sensor by CAN communication and detects the operating speed and the direction of the steering wheel.

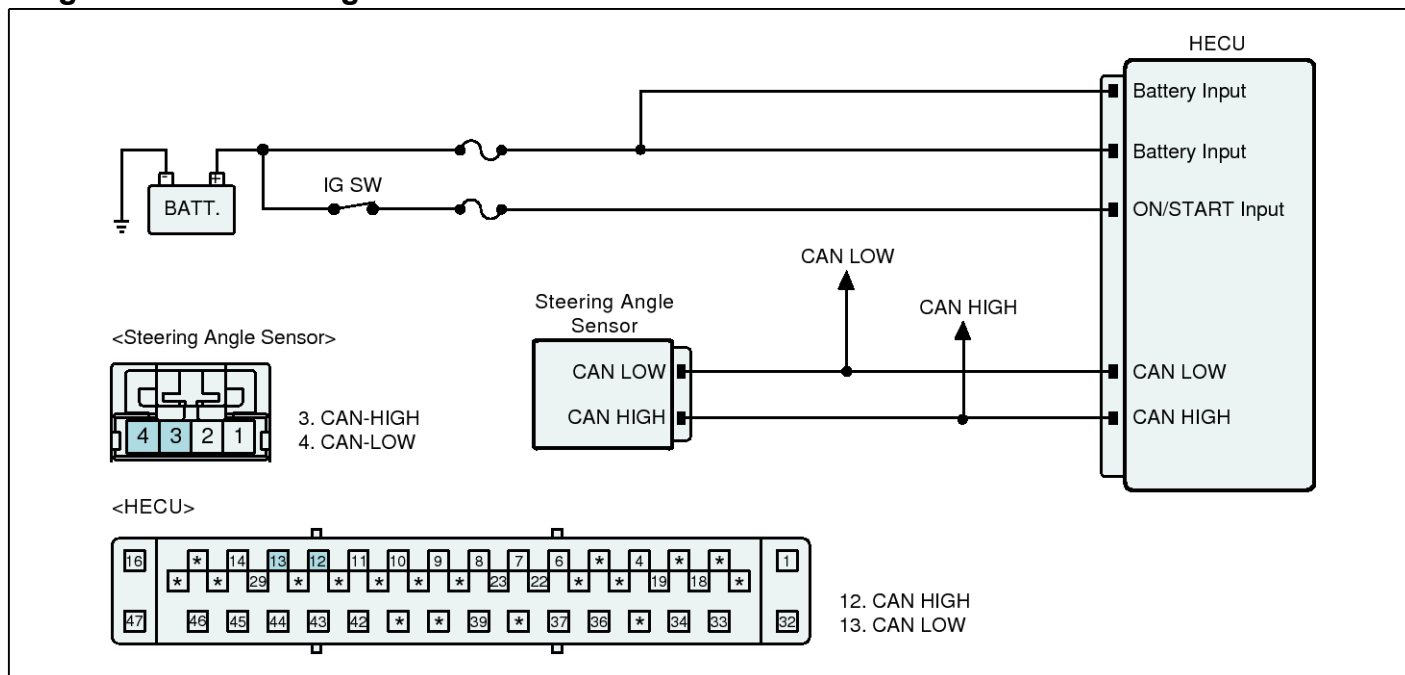
DTC Description

The HECU checks the CAN communication lines for normal control and if a steering angle sensor's message is not received for a certain period, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	CAN message monitoring	- Faulty Steering Angle Sensor (SAS) - Open or short in CAN communication line
Threshold value	When the steering angle sensor's messages are not received for more than 0.5 second with a normal voltage condition	
Fail-Safe	- The TCS/ESP functions are inhibited. - The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SBHBR9513L

BR-156

Brake System

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "CAN Communication line Inspection" procedure.

CAN Communication line Inspection

■ Check CAN communication line

1. IG "OFF"
2. Disconnect Steering Angle Sensor connector and HECU connector.
3. Measure resistance between CAN-High terminal of Steering Angle Sensor harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of Steering Angle Sensor harness connector and CAN-Low terminal of HECU harness connector.

Specification : Below approx. 1Ω

5. Is the measured value within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in the CAN communication line between Steering Angle Sensor and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Operate the steering angle sensor's calibration by scantool.
6. Check if the signal value of the steering angle sensor is within $\pm 2^\circ$ when the angle of the tire is 0° on the scantool.
7. Is the value of the steering angle sensor out of the normal range?

YES ▶ Substitute with a known-good steering angle sensor and check for proper operation. If problem is corrected, replace steering angle sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing the steering angle sensor, operate the steering angle sensor's calibration by scantool.

NO ▶ This fault is intermittently caused by the steering angle sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-157

C1626 Implausible Control

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

If the ESP controlling is abnormally being done, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitoring the ESP control	• Wrong calibration • Faulty sensor • Faulty HECU
Threshold valve	• When the ESP controlling is abnormally being done	
Fail-Safe	• The TCS/ESP functions are inhibited. • The ESP warning lamp is activated.	

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Operate each sensor's calibration again.
6. IG "OFF" and then after about 10 seconds, IG "ON"
7. Using a scantool, Check DTC present.
8. Is the same DTC shown?

YES ▶ Substitute with a known-good HECU/ each sensor and check for proper operation. If problem is corrected, replace HECU/ each sensor and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

※ In a case of replacing the sensor, operate the sensor's calibration by scantool.

NO ▶ This fault may be intermittently caused by poor connection in the HEC connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

BR-158

Brake System

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-159

C1702 Variant Coding Error

General Description

The ESP system is the shorten word of Electronic Stability Program system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication.

There is no difference in the HECU's hardware side according to a vehicle specification, but there is a difference in the its software side because the applied vehicle parameters differ according to a vehicle specification. The HECU stores the variant code value in the ECU's memory based on the received data by CAN communication.

DTC Description

The HECU checks variant code and if an inappropriate variant code or no variant code is detected, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	- Variant coding not carried out - Faulty HECU
Threshold value	when a variant code isn't entered in the HECU	
Fail-Safe	- ABS/ESP functions are inhibited. - ABS/ESP warning lamps are activated.	

Variant coding

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON"
3. Using scantool, Perform Variant coding program.(Fig.1)
4. IG "OFF" and wait for about 10 seconds, and then IG "ON"
5. IG "OFF" and wait for about 10 seconds again, and then, IG "ON"
6. Go to "Component Inspection" procedure.

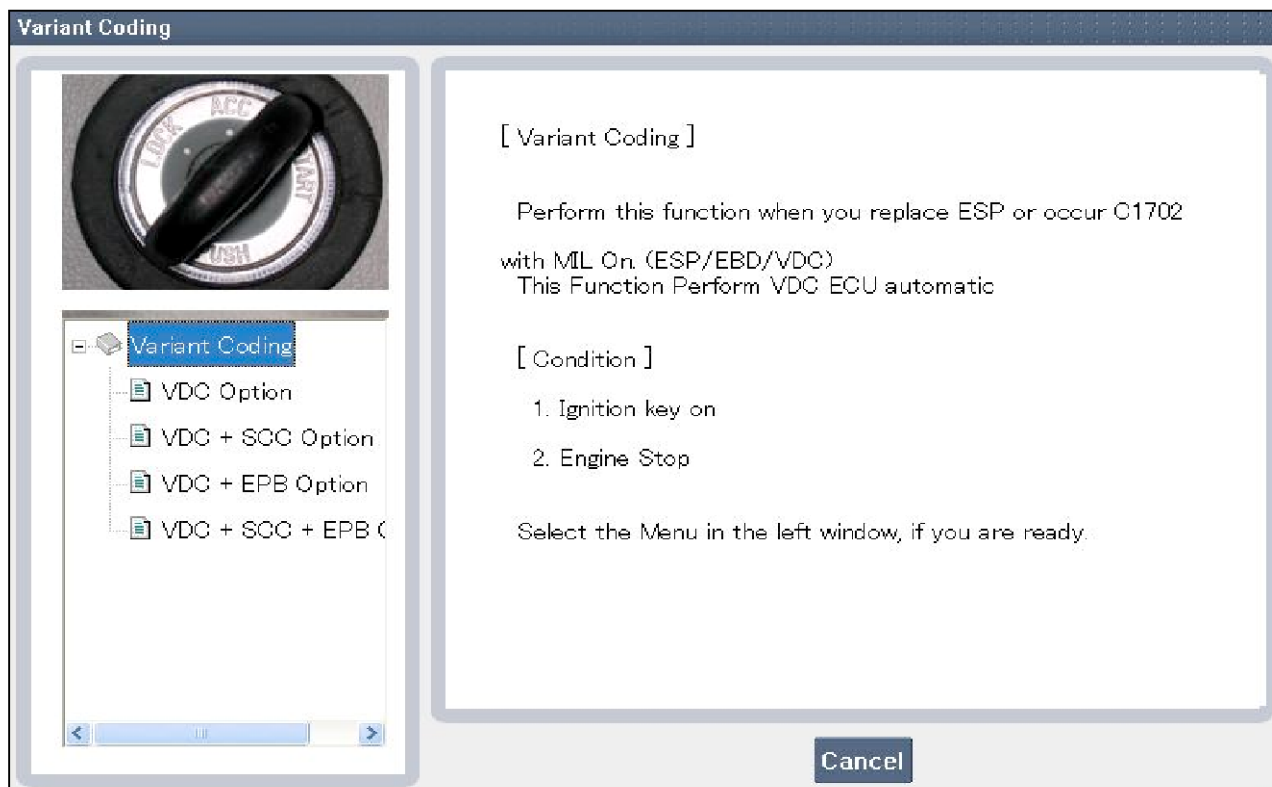


Fig.1

SBHBR9605L

Fig.1) Scantool diagnostic item -VARIANT CODING

Component Inspection

1. IG "OFF"
2. IG "ON" & Engine "OFF"
3. After connecting scantool, Check DTC.
4. Using scantool, Clear DTC.
5. Again using scantool, Check DTC present.
6. Is the same DTC shown, again?

YES ▶ Substitute with a known-good HECU and check for proper operation. If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.NO

NO ▶ Fault is intermittent caused by poor connection in HECU's connector or was repaired and HECU memory was not cleared.
▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-161

C2112 Valve Relay Error

General Description

The HECU supplies battery power to all solenoid valves with a valve relay which is controlled by the Electronic Control UNIT(ECU).

The valve relay and all solenoid valves are installed inside the HECU (Hydraulic and Electronic Control Unit).

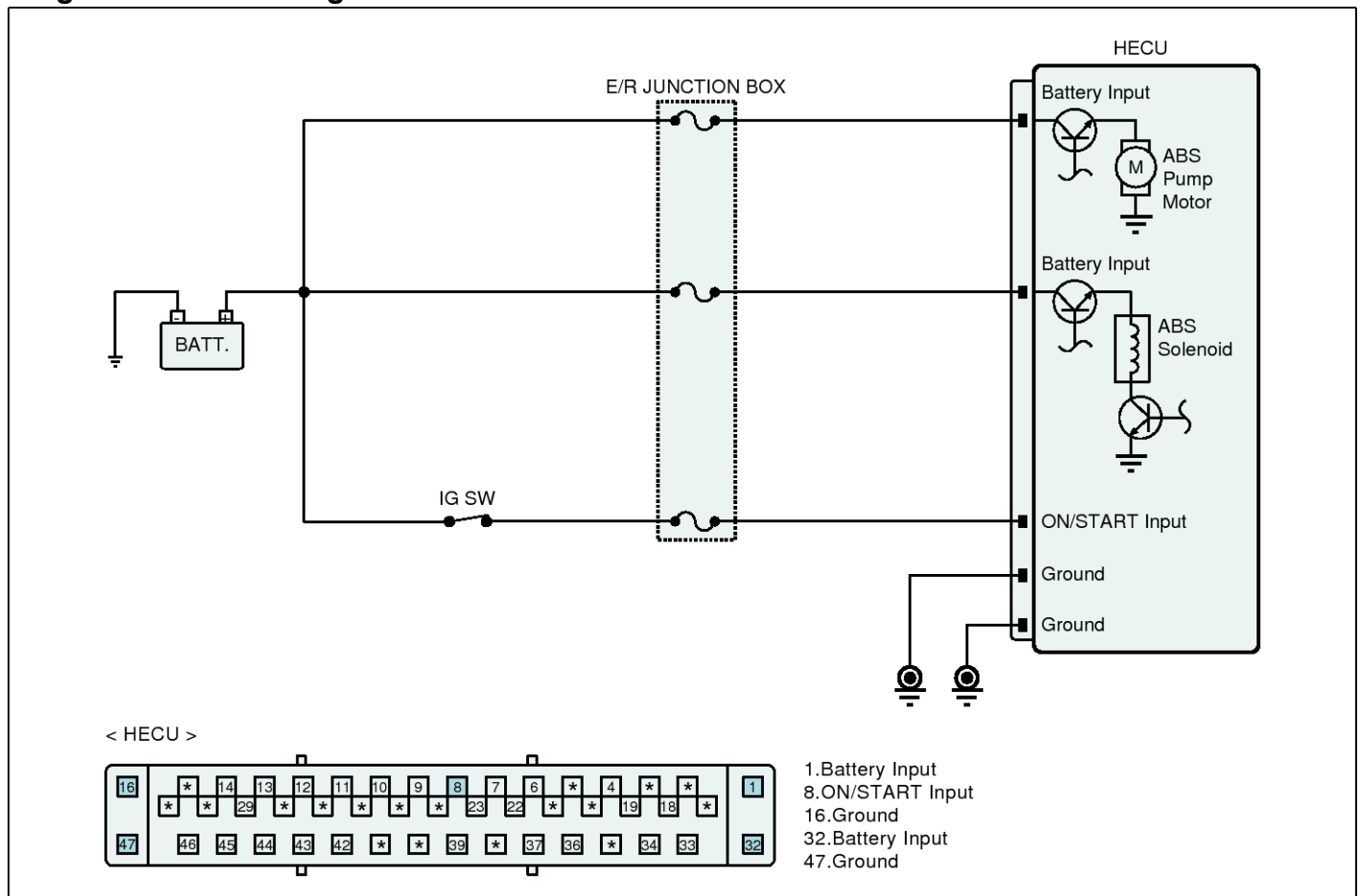
DTC Description

The HECU monitors a voltage of the valve relay for a normal operation and if there is a open or short circuit in the valve relay, this DTC is set.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Voltage monitoring	• Open or short of power supply circuit • Faulty HECU
Case1 (Open)	Threshold value	• When the valve relay is switched on and the reference voltage of valve relay is less than 3V	
Case2 (Short)	Threshold value	• When the valve relay is switched off and the reference voltage of valve relay is more than 3V	
Fail-Safe		• ABS/EBD/TCS/ESP funtions are inhibited. • ABS/EBD/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SBHBR9517L

BR-162

Brake System

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Check for open or short in harness

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the HECU harness connector and chassis ground.

Specification : Battery voltage

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
▶ Repair open or short in power circuit between battery and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Check for open or short in harness

1. IG "OFF"
2. Disconnect HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ Repair open or short in ground circuit between HECU and chassis ground, and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-163

C2227 Excessive Temperature Of Brake Disc

General Description

The BTCS (Brake Traction Control System) is operated when the wheel acceleration and the speed difference exceed the specified value under lower than 50 Km/h(31 MPH). The HECU calculates the wheel disc's temperature logically, which is an assumed value, by using the value of wheel speed, vehicle speed change, control mode and brake light signal. The calculated disc's temperature is used to protect disc from overheating, which is mainly caused by long-time operation.

DTC Description

The HECU calculates a disc's temperature for a normal operation and if the calculated disc's temperature is over 500 °C(932 °F), this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	- Faulty HECU - Overheated brake disc
Threshold value	When the calculated temperature of disc is higher than the predefined value (500 °C/932 °F).	
Fail-Safe	- TCS function is inhibited. - ESP warning lamp is activated.	

Component Inspection

- Wait until the brake disc sufficiently gets cold.
- IG "OFF"
- IG "ON"
- After connecting scantool, Check DTC.
- Using scantool, Clear DTC.
- Again using scantool, Check DTC present.
- Is the same DTC shown, again?

YES ▶ Substitute with a known-good HECU and check for proper operation. If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ Fault is intermittent caused by poor connection in HECU's connector or was repaired and HECU memory was not cleared.

▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
- Using a scantool, Clear DTC.
- Drive the vehicle within DTC Detecting Condition in General Information.
- Using a scantool, Check DTC present.
- Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

BR-164

Brake System

C2308 Front-LH Valve error (Inlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

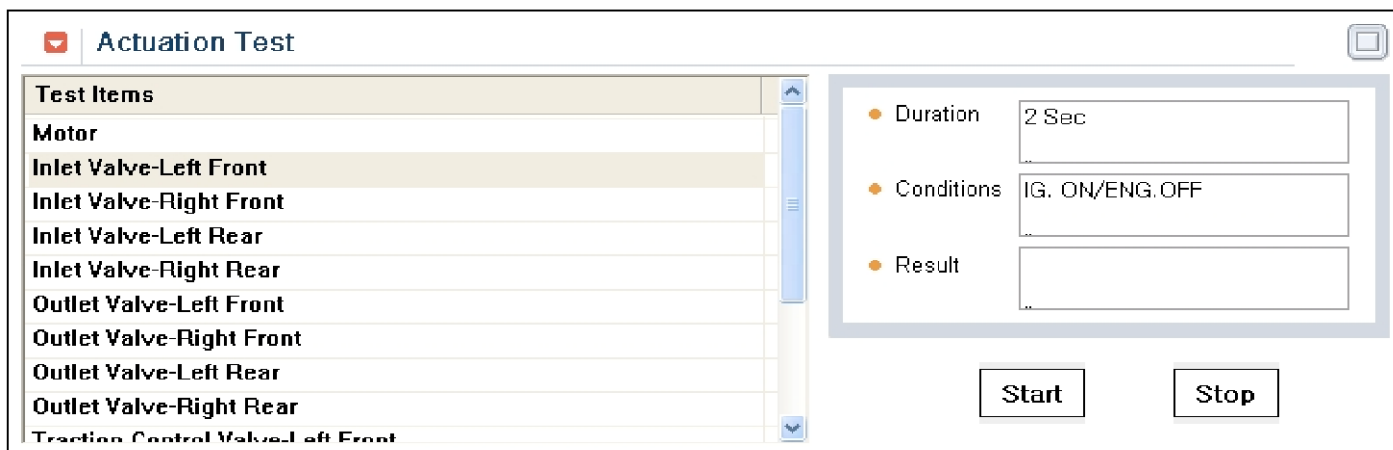


Fig.1

SBHBR9606L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-165

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-166

Brake System

C2312 Front-LH Valve error (Outlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

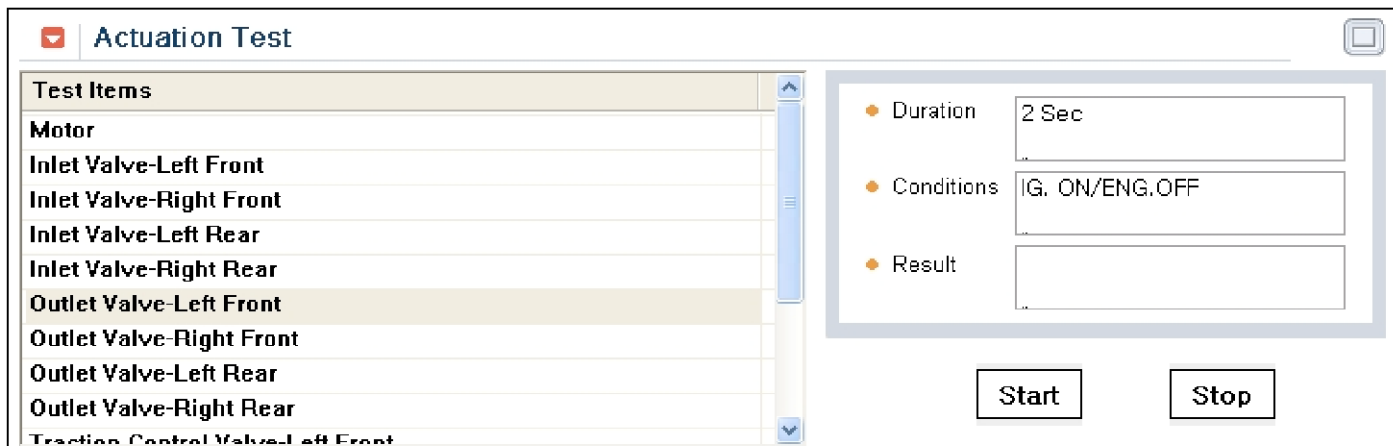


Fig.1

SBHBR9607L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-167

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-168

Brake System

C2316 Front-RH Valve error (Inlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

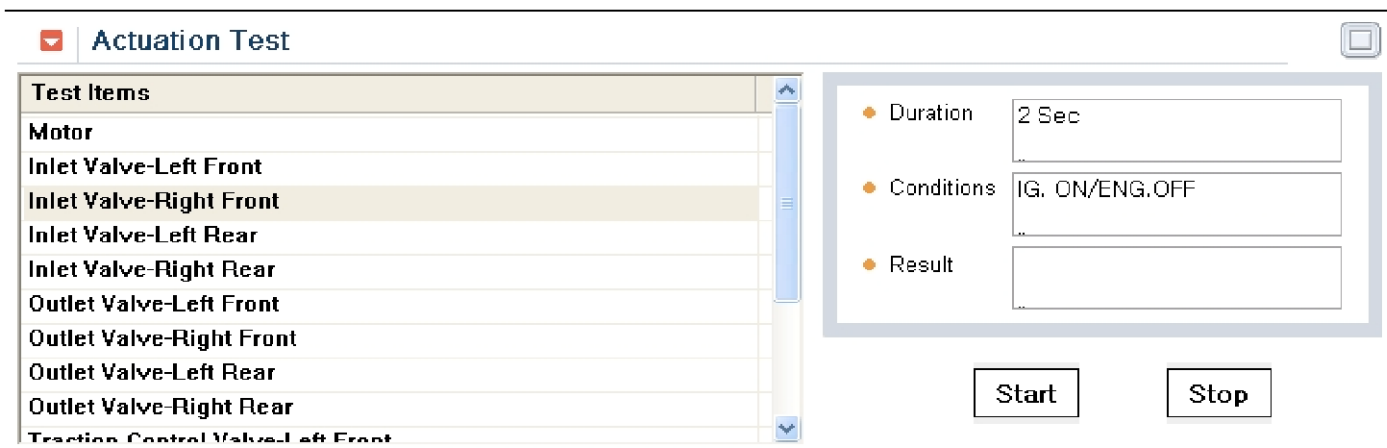


Fig.1

SBHBR9608L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-169

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-170

Brake System

C2320 Front-RH Valve error (Outlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

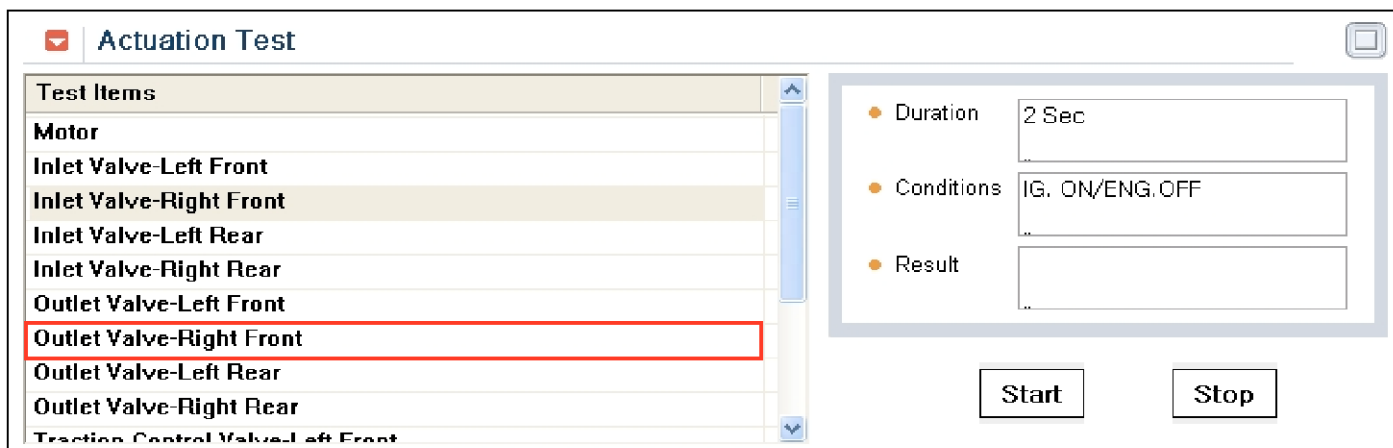


Fig.1

SBHBR9609L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-171

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
- ※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-172

Brake System

C2324 Rear-LH Valve error (Inlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

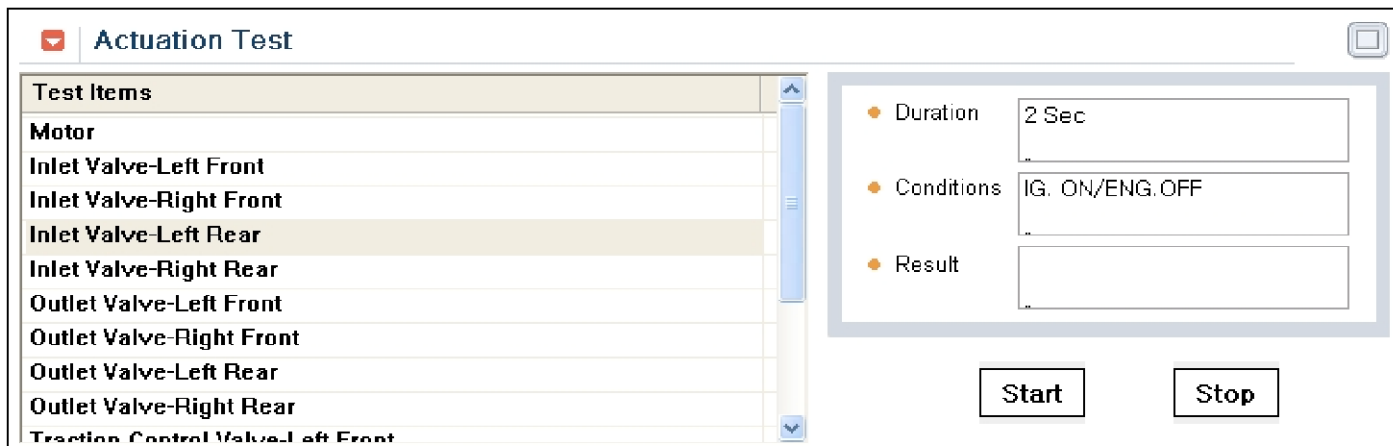


Fig.1

SBHBR9610L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-173

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-174

Brake System

C2328 Rear-LH Valve error (Outlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

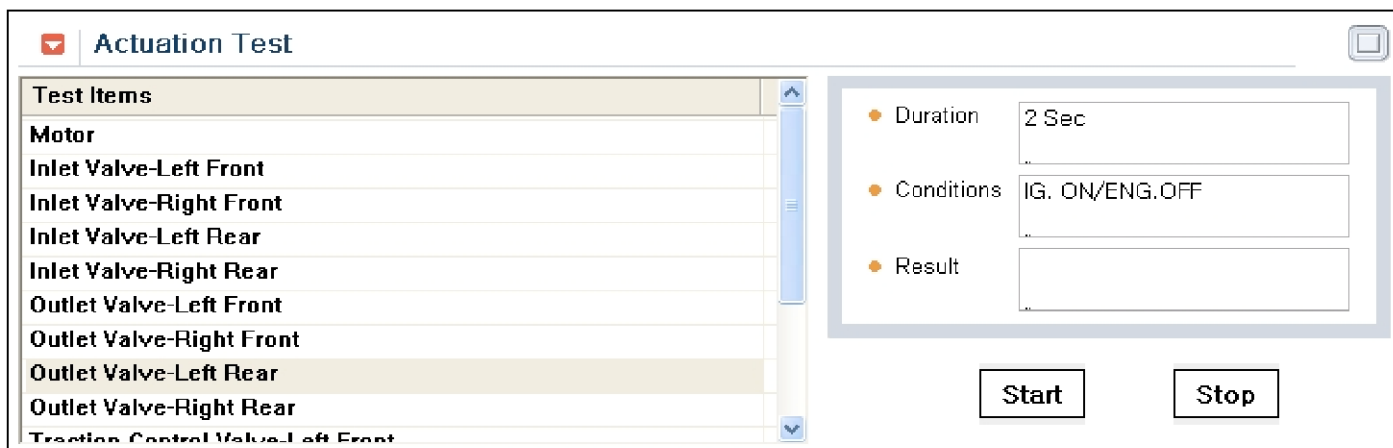


Fig.1

SBHBR9611L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-175

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
- ※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-176

Brake System

C2332 Rear-RH Valve error (Inlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

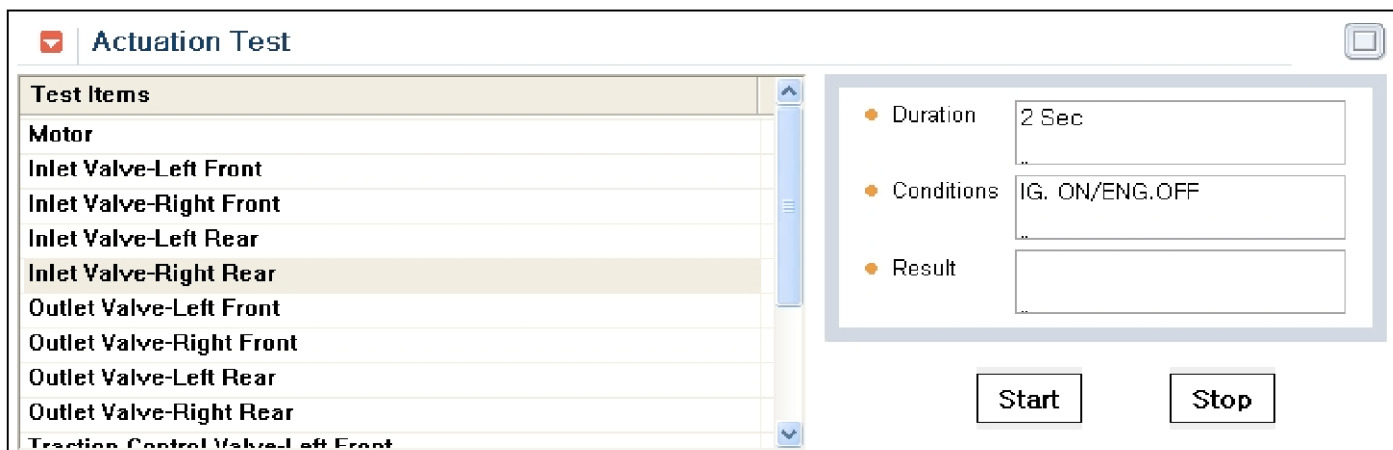


Fig.1

SBHBR9612L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-177

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
- ※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-178

Brake System

C2336 Rear-RH Valve error (Outlet Valve)

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor. And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.

4. Monitor the operating status of the valve by Actuation Test of scantool.

Specification : If the operating sound is heard, it works okay.

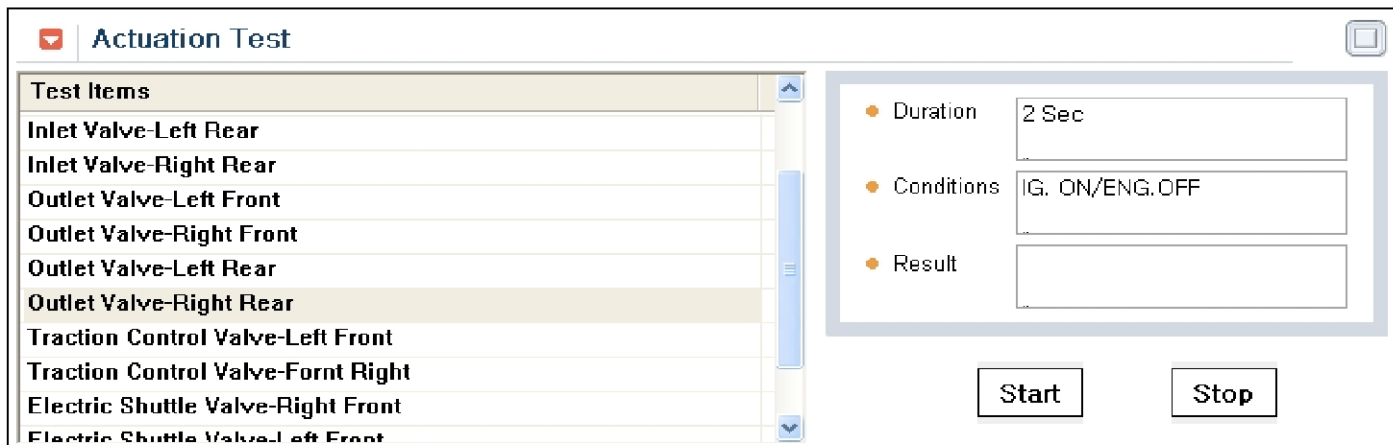


Fig.1

SBHBR9613L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

ESP(Electronic Stability Program) System

BR-179

5. Does the valve operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

- YES** ▶ Substitute with a known-good HECU and check for proper operation.
- If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

- NO** ▶ This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

- YES** ▶ Go to the applicable troubleshooting procedure.

- NO** ▶ System performing to specification at this time.

BR-180

Brake System

C2366 TC Valve Primary (USV1) Error

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor.

And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Internal monitoring	• Faulty HECU
Threshold valve	• When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	• ABS/EBD/ESP funtions are inhibited. • ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.

6. Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-181

C2370 TC Valve Secondary (USV2) Error

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor.

And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

- Ignition "OFF" & Engine "OFF".
- Ignition "ON" & Engine "OFF".
- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- Using a scantool, Clear DTC.
- Using a scantool, Check DTC present.

- Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
- Using a scantool, Clear DTC.
- Drive the vehicle within DTC Detecting Condition in General Information.
- Using a scantool, Check DTC present.
- Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

BR-182

Brake System

C2372 Electronic Shuttle Valve Primary (HSV1) Error

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor.

And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

- Ignition "OFF" & Engine "OFF".
- Ignition "ON" & Engine "OFF".
- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- Using a scantool, Clear DTC.
- Using a scantool, Check DTC present.

- Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
- Using a scantool, Clear DTC.
- Drive the vehicle within DTC Detecting Condition in General Information.
- Using a scantool, Check DTC present.
- Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-183

C2374 Electronic Shuttle Valve Secondary (HSV2) Error

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor.

And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

- Ignition "OFF" & Engine "OFF".
- Ignition "ON" & Engine "OFF".
- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- Using a scantool, Clear DTC.
- Using a scantool, Check DTC present.

- Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
- Using a scantool, Clear DTC.
- Drive the vehicle within DTC Detecting Condition in General Information.
- Using a scantool, Check DTC present.
- Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

BR-184

Brake System

C2380 ABS/TCS/ESP valve error

General Description

The HECU(Hydraulic and Electronic Control Unit) is one body of the ECU(Electronic Control Unit) and HCU(Hydraulic Control Unit). The HCU consists of an accumulator, a return pump and solenoid valve assy. The increasing,maintaining and decreasing of brake pressure to each wheel cylinder is done by the electronic motor.

And the brake pressure in accordance with the control logic is supplied by the pump on the basis of wheel speed sensor's signal.

DTC Description

The HECU monitors the solenoid valve circuit for a normal operation and if there is a open or short circuit in the valve, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Internal monitoring	Faulty HECU
Threshold valve	When there is a open circuit or short circuit in the solenoid valve	
Fail-Safe	- ABS/EBD/ESP funtions are inhibited. - ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

- Ignition "OFF" & Engine "OFF".
- Ignition "ON" & Engine "OFF".
- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- Using a scantool, Clear DTC.
- Using a scantool, Check DTC present.

- Are any DTCs present ?

YES ► Substitute with a known-good HECU and check for proper operation.

If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ► This fault may be intermittently caused by poor connection in the HECU connector or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
- Using a scantool, Clear DTC.
- Drive the vehicle within DTC Detecting Condition in General Information.
- Using a scantool, Check DTC present.
- Are any DTCs present?

YES ► Go to the applicable troubleshooting procedure.

NO ► System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-185

C2402 Motor Failure

General Description

The HECU supplies battery power to the electric motor through the motor relay which is controlled by the Electronic Control Unit(ECU). The electric motor pump supplies hydraulic pressure to all wheel brake calipers by operating the piston inside the pump.

DTC Description

The HECU monitors the pump motor circuit and if it is detected as an open/short circuit, fuse open, or motor lock, this DTC is set.

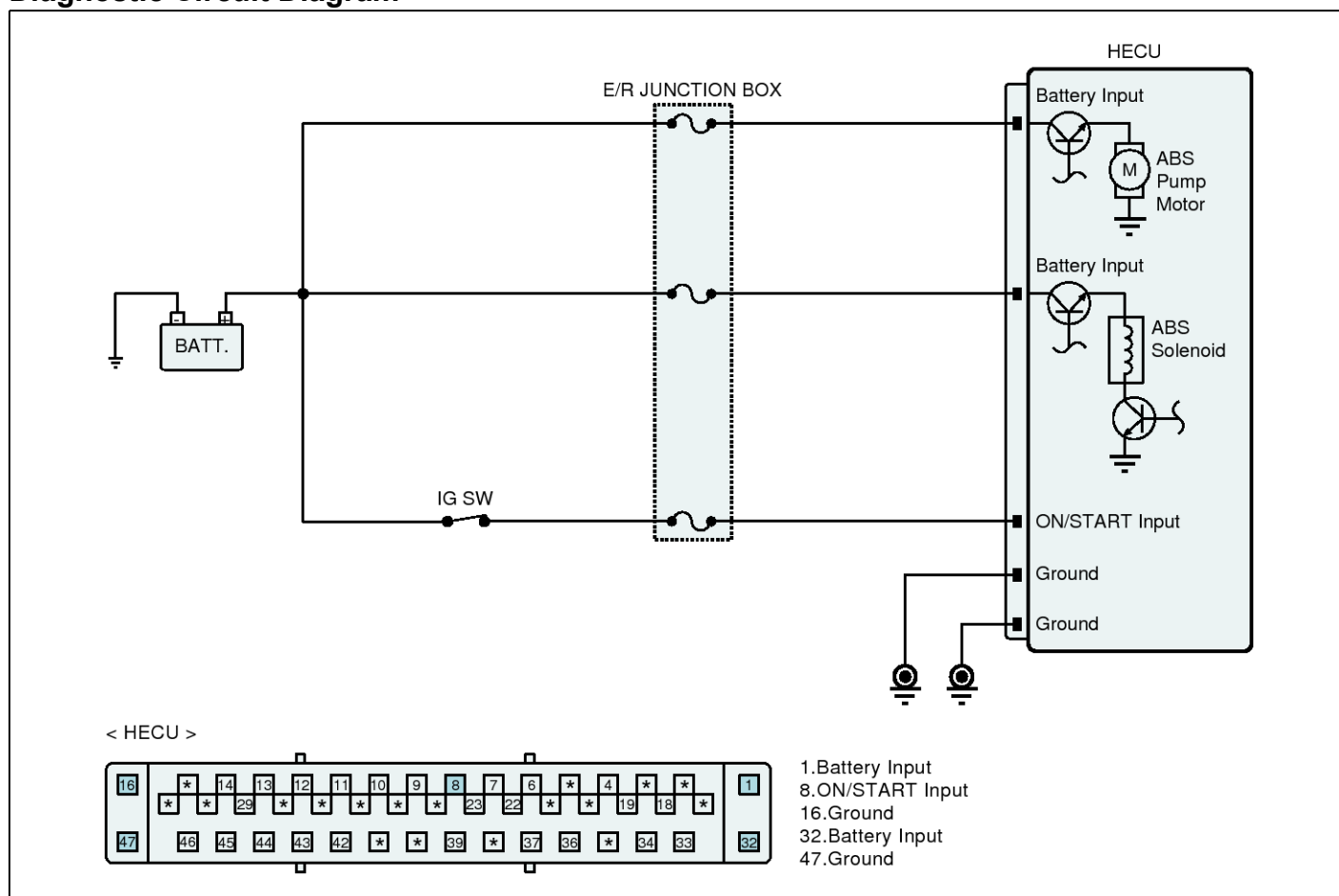
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Voltage monitoring	- Open or short of power supply circuit - Faulty HECU
Threshold value	When the motor pump is activated and the voltage of motor is less than 7.3V for more than 1.8 seconds	
	When the motor pump is not activated and the voltage of motor is over 0.93V for more than 0.93 second	
	When a short circuit happens more than three times.	
	When a short circuit doesn't happen and the mechanical error takes place over ten times.	
Fail-Safe	- ABS/TCS/ESP functions are inhibited. - ABS/ESP warning lamps are activated.	

BR-186

Brake System

Diagnostic Circuit Diagram



SBHBR9517L

Check actuation test

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Select the "Actuation Test" mode on the scantool.
4. Monitor the operating status of the motor by actuation test of scantool.

Specification :

If the operating sound is heard, it works okay.

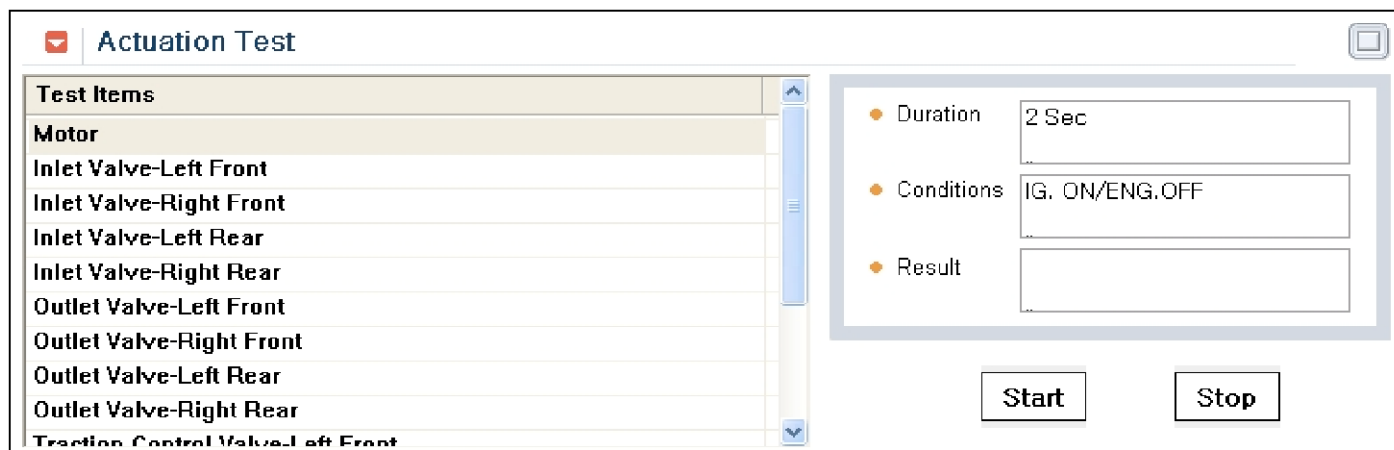


Fig.1

SBHBR9614L

Fig.1) Test Condition : Ignition "ON" & Engine "OFF".

5. Does motor operate normally?

- YES** ▶ Fault is intermittent caused by poor connection in power harness and/or HECU's connector or was repaired and HECU memory was not cleared.
- ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminal condition. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

- YES** ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO** ▶ Go to "Component Inspection" procedure.

Power Circuit Inspection

■ Check for open or short in harness

1. IG "ON"
2. Measure voltage between power terminal of the HECU harness connector and chassis ground.

Specification : Battery voltage

3. Is the measured value within specifications?

- YES** ▶ Go to "Ground Circuit Inspection" procedure.

- NO** ▶ Check for open or blown fuse referring to "Circuit Diagram".
- ▶ Repair open or short in power circuit between battery and HECU and then, go to "Verification of vehicle Repair" procedure.

BR-188

Brake System

Ground Circuit Inspection

■ Check for open or short in harness

1. IG "OFF"
2. Disconnect HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure

※ In a case of replacing HECU, operate each sensor's calibration by scantool, including the steering angle sensor's calibration.

NO ▶ Repair open or short in ground circuit between HECU and chassis ground, and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
2. Using a scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present?

YES ▶ Go to the applicable troubleshooting procedure.

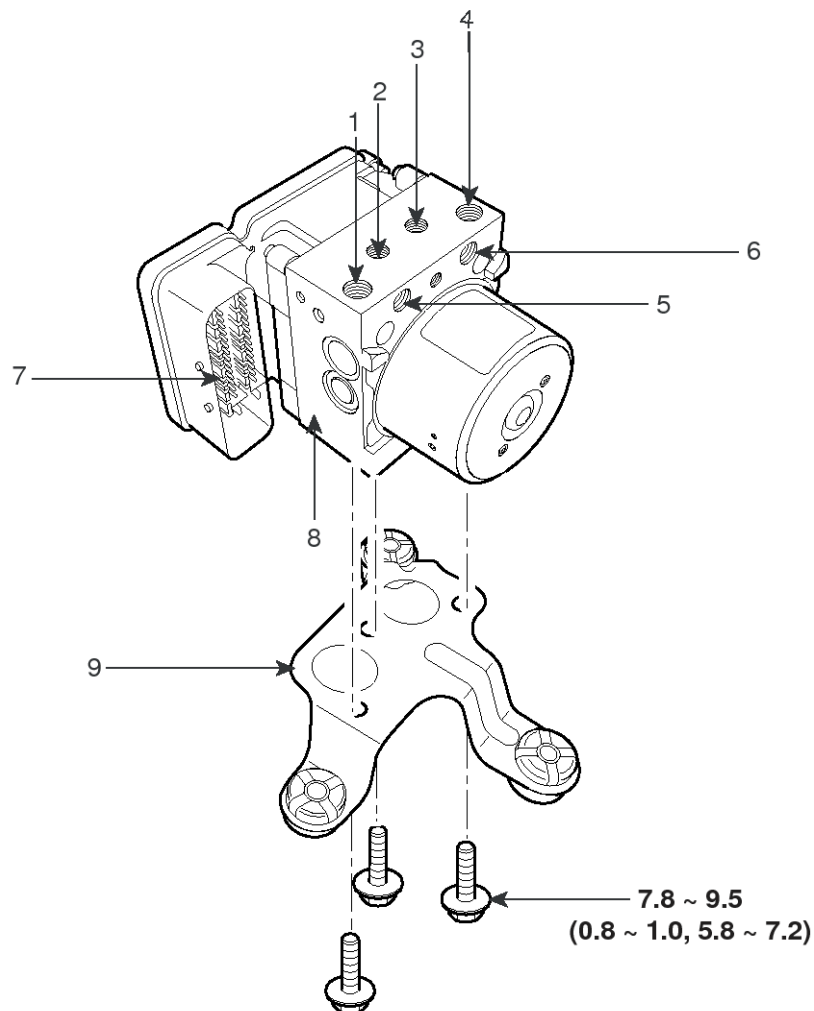
NO ▶ System performing to specification at this time.

ESP(Electronic Stability Program) System

BR-189

ESP Control Unit

Components



Torque : N.m (kgf.m, lb-ft)

SBHBR9331L

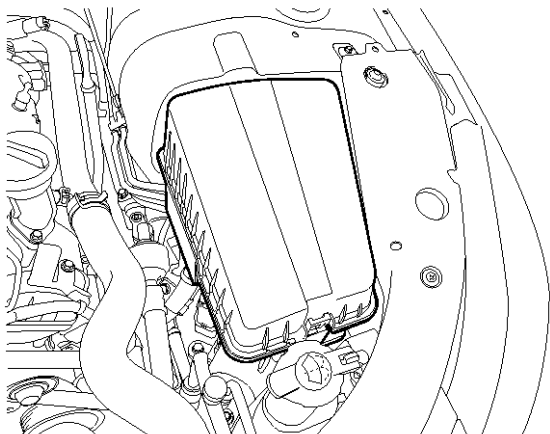
- | | |
|---------------------|---------------------------------|
| 1. MCP | 6. Rear-left tube |
| 2. Front-left tube | 7. ESP control module connector |
| 3. Front-right tube | 8. ESP control module(HECU) |
| 4. MCS | 9. ESP HECU bracket |
| 5. Rear-right tube | |

BR-190

Brake System

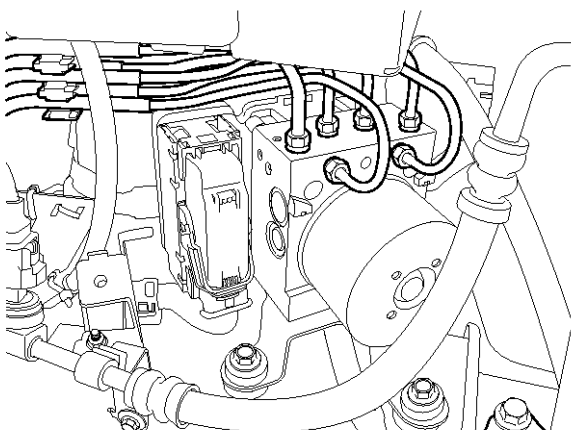
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable
2. Remove the Engine room junction box after removing the cover.



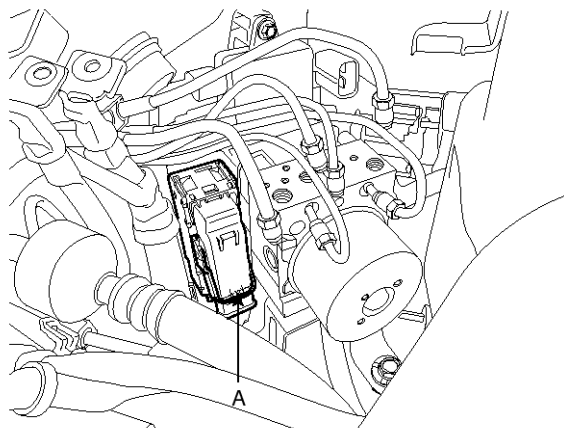
SBHBR8414D

3. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.



SBHBR8400D

4. Pull up the lock (A) of the ESP control unit connector, then disconnect the connector.

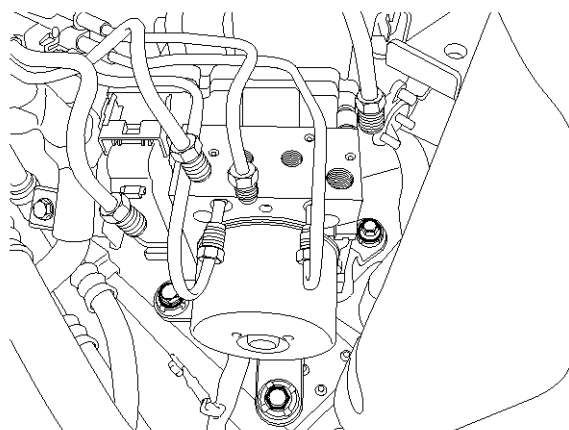


SBHBR9326L

5. Loosen the 3 ESP HECU bracket bolts, then remove HECU and bracket.

Tightening torque:

16.7 ~25.5 Nm (1.7 ~2.6 kgf.m, 112.3 ~18.8 lb-ft)



SBHBR8402D

6. Remove the 3 bolts, then remove the bracket from HECU.

Tightening torque:

7.8 ~9.8 Nm (0.8 ~1.0 kgf.m, 5.8 ~7.2 lb-ft)

⚠ CAUTION

1. Never attempt to disassemble the HECU.
2. The HECU must be transported and stored in.
3. Never shock to the HECU.

Installation

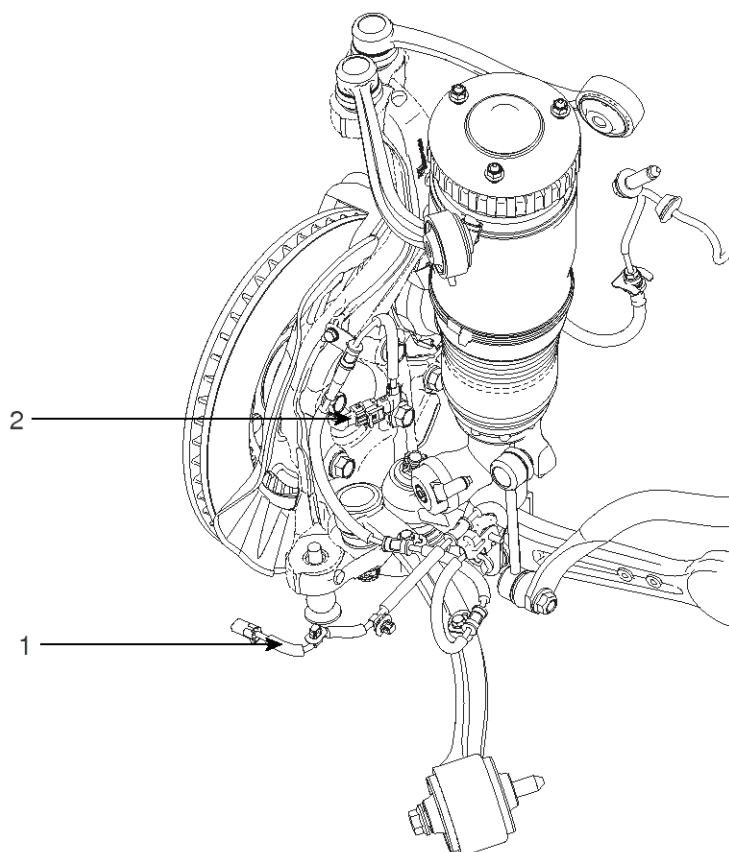
1. Installation is the reverse of removal.

ESP(Electronic Stability Program) System

BR-191

Front Wheel Speed Sensor

Components



SBHBR8403D

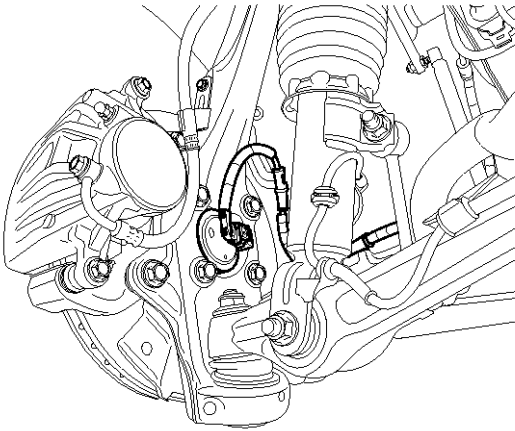
- 1. Front wheel speed sensor cable
- 2. Front wheel speed sensor

BR-192

Brake System

Removal

1. Remove the connector after removing the front wheel speed sensor clip.



SBHBR8405D

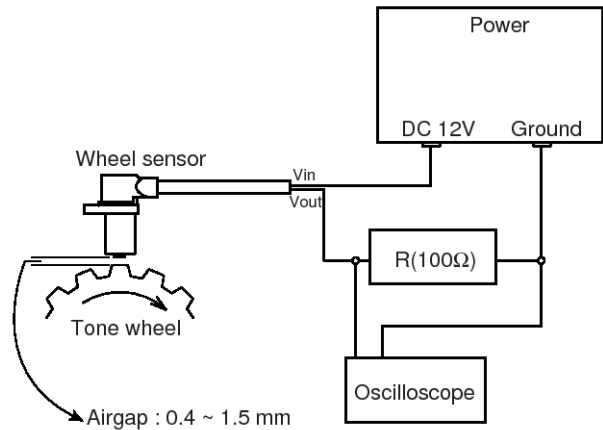
2. Remove the front wheel speed sensor.
(Refer to Driveshaft and Axle group -Front Axle assembly)
3. Installation is the reverse of removal.

Inspection

1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

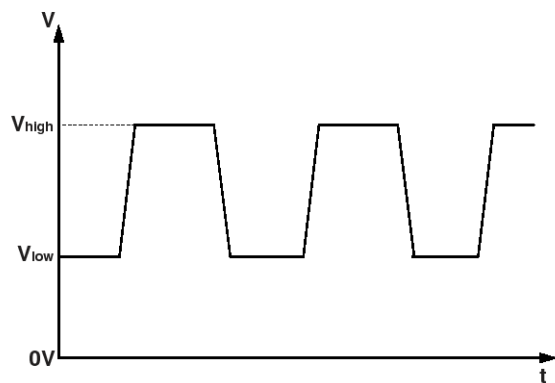
⚠ CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resistor must be used as shown.



LJJF501M

2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



ARJE503Z

V_low: 0.59V ~ 0.84V

V_high: 1.18V ~ 1.68V

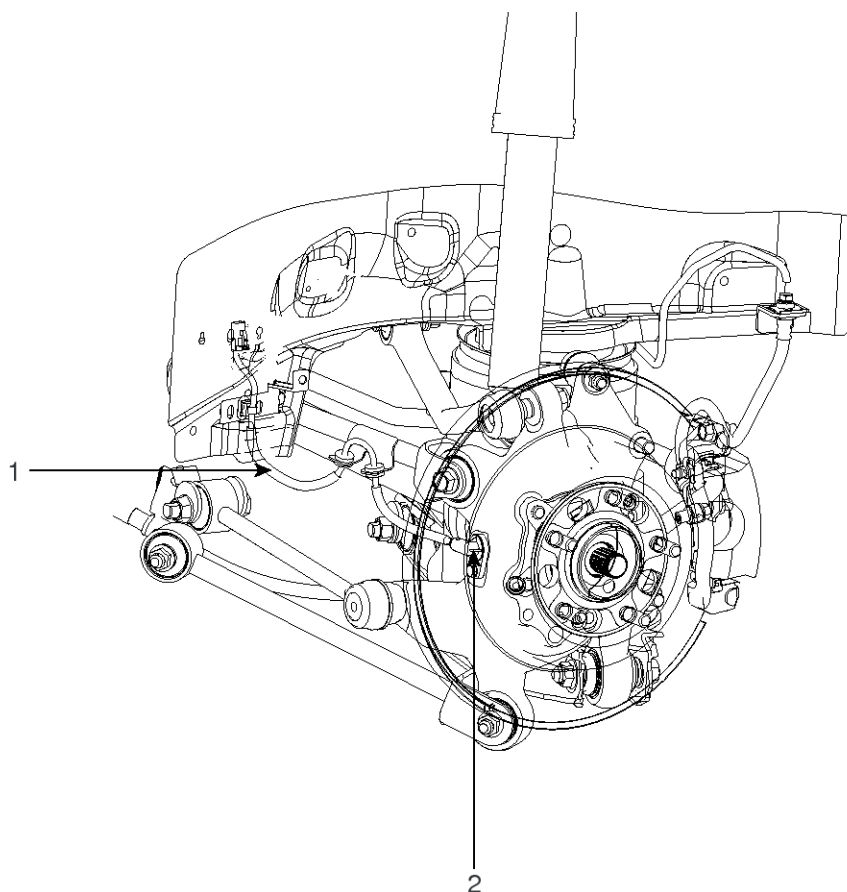
Frequency range: 1 ~ 2,000Hz

ESP(Electronic Stability Program) System

BR-193

Rear Wheel Speed Sensor

Components



SBHBR8406D

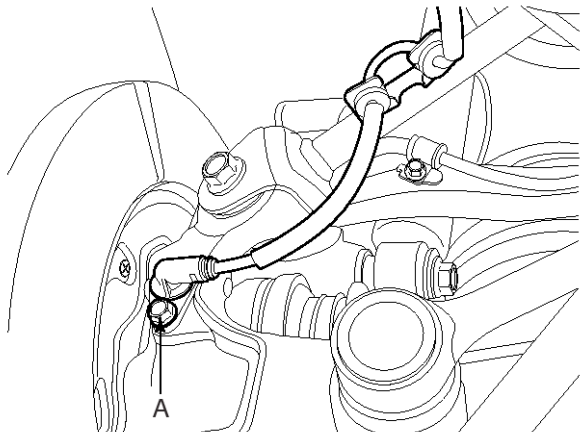
1. Rear wheel speed sensor cable
2. Rear wheel speed sensor

BR-194

Brake System

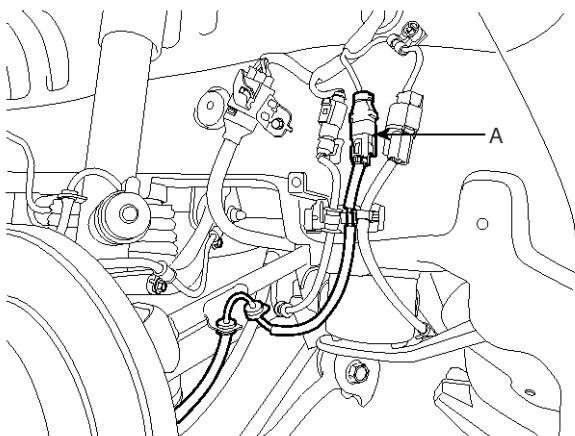
Removal

1. Remove the rear wheel speed sensor mounting bolt.



SBHBR8407D

2. Remove the rear wheel guard.
3. Disconnect the rear wheel speed sensor connector (A), then remove the rear wheel speed sensor.



SBHBR8408D

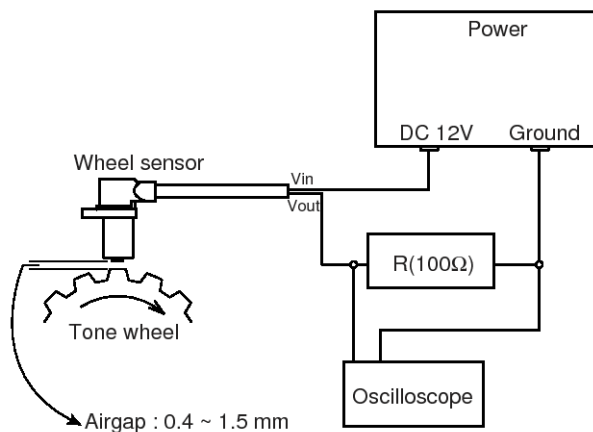
4. Installation is the reverse of removal.

Inspection

1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

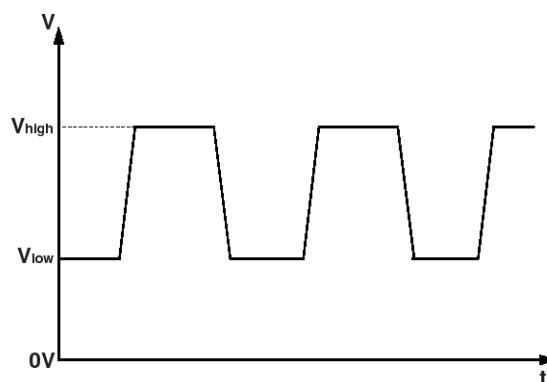
⚠ CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resistor must be used as shown.



LJJF501M

2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



ARJE503Z

V_{low} : 0.59V ~ 0.84V

V_{high} : 1.18V ~ 1.68V

Frequency range: 1 ~ 2,000Hz

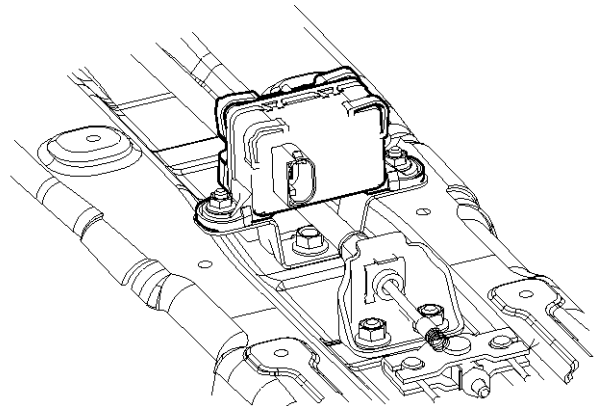
ESP(Electronic Stability Program) System

BR-195

Yaw-rate and Lateral G Sensor

Description

The ESP system is the shorten word of Electronic Stability Control system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. Among components of this system, the yaw-rate & lateral G sensor is installed on the lower of the center console. The yaw-rate and lateral G sensor are installed together in the one container which is called as " Sensor cluster". When the vehicle is moving around a vertical axis, the yaw rate sensor senses the vibration changes of the plate-fork installed in the yaw-rate sensor. When the vehicle's yawing is sensed and the yaw velocity reaches a certain velocity, the ESP control is activated. The lateral G sensor senses a vehicle's lateral acceleration. A small element in the sensor is attached to a deflectable lever-arm. The HECU recognizes a vehicle's direction and a lateral acceleration by the lateral G sensor.

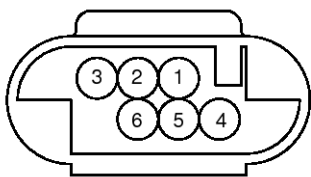


SBHBR8409D

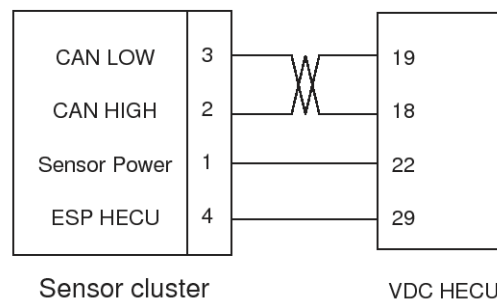
Specifications

Description	Specification	Remarks
Operating voltage	8 ~ 16V	
Current Consumption	Max. 250mA	
Operating temperature	-40 ~ 85℃	
Yaw-rate sensor Measurement range	-75 ~ 75°/sec	
Lateral G sensor Measurement range	-1.7gN ~ +1.7gN	

External Diagram



[Sensor cluster connector]



SBHBR9315L

BR-196

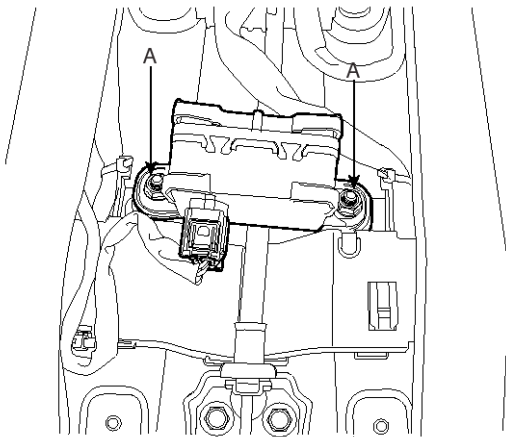
Brake System

Replacement

1. Turn ignition switch OFF and disconnect the negative (-) battery cable
2. Remove the floor console. (Refer to the Body group - console)
3. Disconnect the yaw rate & lateral G sensor connector.
4. Remove the mounting bolts (A).

Tightening torque:

6.9 ~ 8.8 Nm (0.7 ~ 0.9 kgf.m, 5.1 ~ 6.5 lb-ft)



SBHBR8411D

5. Installation is the reverse of removal.

ESP(Electronic Stability Program) System

BR-197

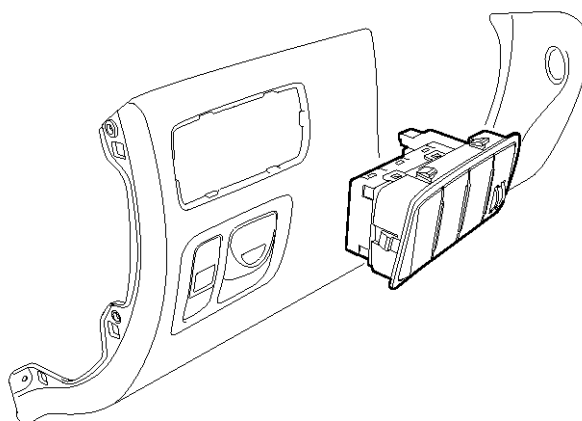
ESP OFF Switch

Description

1. The ESP OFF switch is for the user to turn off the ESP system.
2. The ESP OFF lamp is on when ESP OFF switch is engaged.

Inspection

1. Turn ignition switch OFF and disconnect the negative (-) battery cable
2. Remove the crash pad side cover. (Refer to the Body group- crash pad)
3. Remove the lower panel. (Refer to the Body group- crash pad)
4. Remove the lower crash pad switch assembly by using the scraper and then disconnect the connectors.



SBHBR8412D

5. Check the continuity between the switch terminals as the ESP OFF switch is engaged.

Terminal Position	16	14	13	12
ON	○	○	○	○
OFF			○	○

SBHBR9316L

BR-198

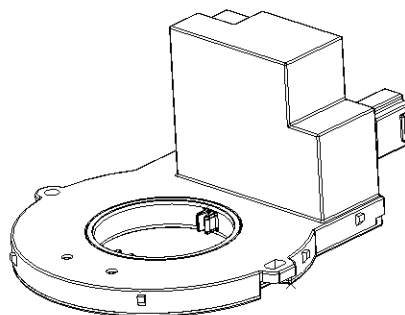
Brake System

Steering Angle Sensor

Description

Steering Wheel Angle Sensor detects rotating direction of the vehicle. Rotating direction detected by the sensor is communicated with HECU as CAN signal involving information about the angle through CAN communication line.

HECU detects speed of the steering wheel handling and the angle with this CAN signal. HECU also uses this signal as the input signal to control anti-roll.

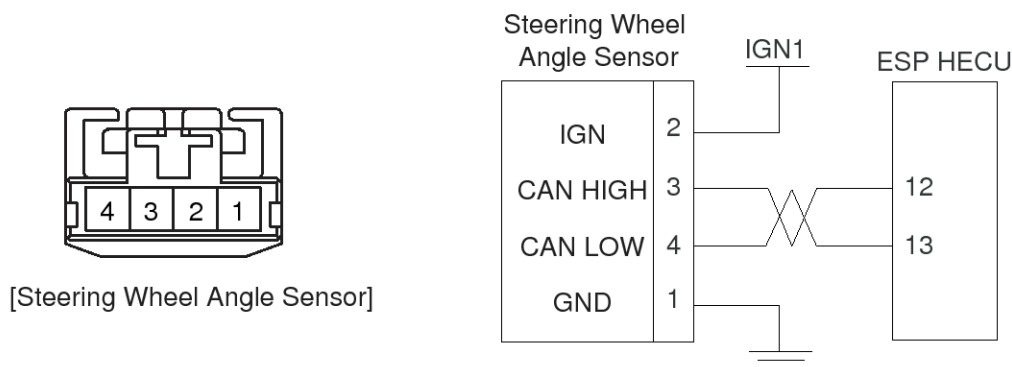


SHMBR8358D

Specification

Description		Specification
Operating voltage		8 ~ 16V
Operating temperature		-40 ~ 85°C
Current consumption		Max.150mA
Measuring range	Angle	-780 ~ 779.9°
	Angular velocity	0 ~ 1016°/sec

Circuit Diagram



SBHBR9317L

ESP(Electronic Stability Program) System

BR-199

Calibration (Setting up the zero angle)

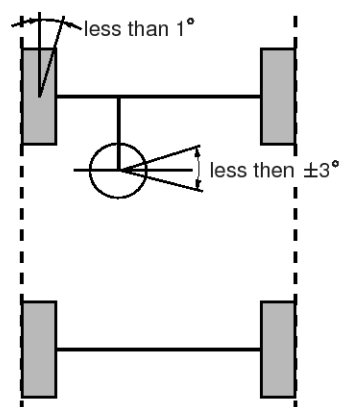
Steering Wheel Angle Sensor of a absolute angle type (CAN type) measures the angle under the standard of the zero angle set

Calibration must be performed as following cases.

- Replacement of the Steering Wheel Angle Sensor
- Replacement or repair of the Steering column
- Detection of DTC codes (C1260, C1261)
- Replacement of the sensor cluster
- Replacement of HECU

Calibration procedure

Perform wheel alignment and stand the steering wheel in a line within $\pm 3^\circ$ error.



SBHBR9318L

1. Connect the scan tool.(CAN line or OBD connector)
2. Turn ignition switch on.
3. Press calibration button of the Steering Wheel Angle Sensor.
4. HECU calibration procedure is performed.
(Calibration records, DTC codes erasure)
5. Turn ignition switch off after calibration procedure.
6. Confirm success or failure of calibration.
 - Warning lamp must not be lighted when driving test (Turning left and right).
 - ESP lights ESP warning lamp when making an error in comparison with values of other sensors.

50